MiCOM P114D

Dual / CT Powered Overcurrent Relay

P114D/EN M/A11

Software Version 1A
Hardware Suffix A

Техническое руководство MICOM P114

Note: The technical manual for this device gives instructions for its installation, commissioning, and operation. However, the manual cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact the appropriate Schneider Electric technical sales office and request the necessary information.

Any agreements, commitments, and legal relationships and any obligations on the part of Schneider Electric including settlements of warranties, result solely from the applicable purchase contract, which is not affected by the contents of the technical manual.

This device MUST NOT be modified. If any modification is made without the express permission of Schneider Electric, it will invalidate the warranty, and may render the product unsafe.

CONTENTS

SAFETY SECTION

STANDARD SAFETY STATEMENTS AND EXTERNAL LABEL INFORMATION FOR SCHNEIDER ELECTRIC EQUIPMENT

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1. INTRODUCTION

This guide and the relevant equipment documentation provide full information on safe handling, commissioning and testing of this equipment. This Safety Guide also includes descriptions of equipment label markings.

Documentation for equipment ordered from Schneider Electric is despatched separately from manufactured goods and may not be received at the same time. Therefore this guide is provided to ensure that printed information which may be present on the equipment is fully understood by the recipient.

The technical data in this safety guide is typical only, see the technical data section of the relevant product publication(s) for data specific to a particular equipment.

Before carrying out any work on the equipment the user should be familiar with the contents of this Safety Guide and the ratings on the equipment's rating label.

Reference should be made to the external connection diagram before the equipment is installed, commissioned or serviced.

Language specific, self-adhesive User Interface labels are provided in a bag for some equipment.

2. HEALTH AND SAFETY

The information in the Safety Section of the equipment documentation is intended to ensure that equipment is properly installed and handled in order to maintain it in a safe condition.

It is assumed that everyone who will be associated with the equipment will be familiar with the contents of that Safety Section, or this Safety Guide.

When electrical equipment is in operation, dangerous voltages will be present in certain parts of the equipment. Failure to observe warning notices, incorrect use, or improper use may endanger personnel and equipment and also cause personal injury or physical damage.

Before working in the terminal strip area, the equipment must be isolated.

Proper and safe operation of the equipment depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing. For this reason only qualified personnel may work on or operate the equipment.

Qualified personnel are individuals who:

- Are familiar with the installation, commissioning, and operation of the equipment and of the system to which it is being connected;
- Are able to safely perform switching operations in accordance with accepted safety engineering practices and are authorised to energize and de-energize equipment and to isolate, ground, and label it;
- Are trained in the care and use of safety apparatus in accordance with safety engineering practices;
- Are trained in emergency procedures (first aid).

The equipment documentation gives instructions for its installation, commissioning, and operation. However, the manual cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact the appropriate Schneider Electric technical sales office and request the necessary information.

3. SYMBOLS AND EXTERNAL LABELS ON THE EQUIPMENT

For safety reasons the following symbols and external labels, which may be used on the equipment or referred to in the equipment documentation, should be understood before the equipment is installed or commissioned.

3.1 Symbols

 Caution: refer to equipment documentation	 Caution: risk of electric shock
 Protective Conductor (*Earth) terminal	 Functional/Protective Conductor (*Earth) terminal. Note: This symbol may also be used for a Protective Conductor (Earth) Terminal if that terminal is part of a terminal block or sub-assembly e.g. power supply.

*NOTE: THE TERM EARTH USED THROUGHOUT THIS GUIDE IS THE DIRECT EQUIVALENT OF THE NORTH AMERICAN TERM GROUND.

3.2 Labels

See Safety Guide (SFTY/4L M/G11) for equipment labelling information.

4. INSTALLING, COMMISSIONING AND SERVICING

Equipment connections

Personnel undertaking installation, commissioning or servicing work for this equipment should be aware of the correct working procedures to ensure safety.

The equipment documentation should be consulted before installing, commissioning, or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

The clamping screws of all terminal block connectors, for field wiring, using M4 screws shall be tightened to a nominal torque of 1.3 Nm.

Equipment intended for rack or panel mounting is for use on a flat surface of a Type 1 enclosure, as defined by Underwriters Laboratories (UL).

Any disassembly of the equipment may expose parts at hazardous voltage, also electronic parts may be damaged if suitable electrostatic voltage discharge (ESD) precautions are not taken.

If there is unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electric shock or energy hazards.

Voltage and current connections shall be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety.

Watchdog (self-monitoring) contacts are provided in numerical relays to indicate the health of the device. Schneider Electric strongly recommends that these contacts are hardwired into the substation's automation system, for alarm purposes.

To ensure that wires are correctly terminated the correct crimp terminal and tool for the wire size should be used.

The equipment must be connected in accordance with the appropriate connection diagram.

Protection Class I Equipment

- Before energizing the equipment it must be earthed using the protective conductor terminal, if provided, or the appropriate termination of the supply plug in the case of plug connected equipment.
- The protective conductor (earth) connection must not be removed since the protection against electric shock provided by the equipment would be lost.
- When the protective (earth) conductor terminal (PCT) is also used to terminate cable screens, etc., it is essential that the integrity of the protective (earth) conductor is checked after the addition or removal of such functional earth connections. For M4 stud PCTs the integrity of the protective (earth) connections should be ensured by use of a locknut or similar.

The recommended minimum protective conductor (earth) wire size is 2.5 mm^2 (3.3 mm^2 for North America) unless otherwise stated in the technical data section of the equipment documentation, or otherwise required by local or country wiring regulations.

The protective conductor (earth) connection must be low-inductance and as short as possible.

All connections to the equipment must have a defined potential. Connections that are pre-wired, but not used, should preferably be grounded when binary inputs and output relays are isolated. When binary inputs and output relays are connected to common potential, the pre-wired but unused connections should be connected to the common potential of the grouped connections.

Before energizing the equipment, the following should be checked:

- Voltage rating/polarity (rating label/equipment documentation),
- CT circuit rating (rating label) and integrity of connections,
- Protective fuse rating,
- Integrity of the protective conductor (earth) connection (where applicable),
- Voltage and current rating of external wiring, applicable to the application.

Accidental touching of exposed terminals

If working in an area of restricted space, such as a cubicle, where there is a risk of electric shock due to accidental touching of terminals which do not comply with IP20 rating, then a suitable protective barrier should be provided.

Equipment use

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Removal of the equipment front panel/cover

Removal of the equipment front panel/cover may expose hazardous live parts, which must not be touched until the electrical power is removed.

UL and CSA/CUL Listed or Recognized equipment

To maintain UL and CSA/CUL Listing/Recognized status for North America the equipment should be installed using UL or CSA Listed or Recognized parts for the following items: connection cables, protective fuses/fuseholders or circuit breakers, insulation crimp terminals and replacement internal battery, as specified in the equipment documentation.

For external protective fuses a UL or CSA Listed fuse shall be used. The Listed type shall be a Class J time delay fuse, with a maximum current rating of 15 A and a minimum d.c. rating of 250 Vd.c., for example type AJT15.

Where UL or CSA Listing of the equipment is not required, a high rupture capacity (HRC) fuse type with a maximum current rating of 16 Amps and a minimum d.c. rating of 250 Vd.c. may be used, for example Red Spot type NIT or TIA.

Equipment operating conditions

The equipment should be operated within the specified electrical and environmental limits.

Current transformer circuits

Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation. Generally, for safety, the secondary of the line CT must be shorted before opening any connections to it.

For most equipment with ring-terminal connections, the threaded terminal block for current transformer termination has automatic CT shorting on removal of the module. Therefore external shorting of the CTs may not be required, the equipment documentation should be checked to see if this applies.

For equipment with pin-terminal connections, the threaded terminal block for current transformer termination does NOT have automatic CT shorting on removal of the module.

External resistors, including voltage dependent resistors (VDRs)

Where external resistors, including voltage dependent resistors (VDRs), are fitted to the equipment, these may present a risk of electric shock or burns, if touched.

Battery replacement

Where internal batteries are fitted they should be replaced with the recommended type and be installed with the correct polarity to avoid possible damage to the equipment, buildings and persons.

Insulation and dielectric strength testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.

Insertion of modules and pcb cards

Modules and PCB cards must not be inserted into or withdrawn from the equipment whilst it is energized, since this may result in damage.

Insertion and withdrawal of extender cards

Extender cards are available for some equipment. If an extender card is used, this should not be inserted or withdrawn from the equipment whilst it is energized. This is to avoid possible shock or damage hazards. Hazardous live voltages may be accessible on the extender card.

External test blocks and test plugs

Great care should be taken when using external test blocks and test plugs such as the MMLG, MMLB and MiCOM P990 types, hazardous voltages may be accessible when using these. *CT shorting links must be in place before the insertion or removal of MMLB test plugs, to avoid potentially lethal voltages.

*Note: When a MiCOM P992 Test Plug is inserted into the MiCOM P991 Test Block, the secondaries of the line CTs are automatically shorted, making them safe.

Fiber optic communication

Where fiber optic communication devices are fitted, these should not be viewed directly. Optical power meters should be used to determine the operation or signal level of the device.

Cleaning

The equipment may be cleaned using a lint free cloth dampened with clean water, when no connections are energized. Contact fingers of test plugs are normally protected by petroleum jelly, which should not be removed.

5. DECOMMISSIONING AND DISPOSAL

De-commissioning

The supply input (auxiliary) for the equipment may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the equipment (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to de-commissioning.

Disposal

It is recommended that incineration and disposal to water courses is avoided. The equipment should be disposed of in a safe manner. Any equipment containing batteries should have them removed before disposal, taking precautions to avoid short circuits. Particular regulations within the country of operation, may apply to the disposal of the equipment.

6. TECHNICAL SPECIFICATIONS FOR SAFETY

Unless otherwise stated in the equipment technical manual, the following data is applicable.

6.1 Protective fuse rating

The recommended maximum rating of the external protective fuse for equipments is 16A, high rupture capacity (HRC) Red Spot type NIT, or TIA, or equivalent. Unless otherwise stated in equipment technical manual, the following data is applicable. The protective fuse should be located as close to the unit as possible.

CAUTION - CTs must NOT be fused since open circuiting them may produce lethal hazardous voltages.

6.2 Protective Class

IEC 60255-27: 2005 EN 60255-27: 2006	Class I (unless otherwise specified in the equipment documentation). This equipment requires a protective conductor (earth) connection to ensure user safety.

6.3 Installation Category

IEC 60255-27: 2005 EN 60255-27: 2006	Installation Category III (Overvoltage Category III): Distribution level, fixed installation. Equipment in this category is qualification tested at 5 kV peak, 1.2/50 µs, 500 Ω, 0.5 J, between all supply circuits and earth and also between independent circuits.

6.4 Environment

The equipment is intended for indoor installation and use only. If it is required for use in an outdoor environment then it must be mounted in a specific cabinet or housing which will enable it to meet the requirements of IEC 60529 with the classification of degree of protection IP54 (dust and splashing water protected).

Pollution Degree - Pollution Degree 2 Altitude - Operation up to 2000m IEC 60255-27:2005 EN 60255-27: 2006	Compliance is demonstrated by reference to safety standards.

INTRODUCTION

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

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CONTENTS

FIGURES

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1. MICOM DOCUMENTATION STRUCTURE

The manual provides a functional and technical description of the MiCOM protection relay and a comprehensive set of instructions for the relay's use and application.

The section contents are summarized below:

P114D/EN IT Introduction

A guide to the MiCOM range of relays and the documentation structure. Also a general functional overview of the relay and brief application summary are given.

P114D/EN TD Technical Data

Technical data including setting ranges, accuracy limits, recommended operating conditions, ratings and performance data. Compliance with norms and international standards is quoted where appropriate.

P114D/EN GS Getting Started

A guide to the different user interfaces of the protection relay describing how to start using it. This section provides detailed information regarding the communication interfaces of the relay, including a detailed description of how to access the settings database stored within the relay.

P114D/EN ST Settings

List of all relay settings, including ranges, step sizes and defaults, together with a brief explanation of each setting.

P114S/EN OP Operation

A comprehensive and detailed functional description of all protection and non-protection functions.

P114D/EN AP Application Notes

This section includes a description of common power system applications of the relay, calculation of suitable settings, some typical worked examples, and how to apply the settings to the relay.

P114D/EN MR Measurements and Recording

Detailed description of the relay's recording and measurements functions.

P114D/EN CM Commissioning

Instructions on how to commission the relay, comprising checks on the calibration and functionality of the relay.

P114D/EN MT Maintenance

A general maintenance policy for the relay is outlined.

P114D/EN TS Troubleshooting

Advice on how to recognize failure modes and the recommended course of action. Includes guidance on who at Schneider Electric to contact for advice.

P114D/EN SG Symbols and Glossary

List of common technical abbreviations found within the product documentation.

P114D/EN IN Installation

Recommendations on unpacking, handling, inspection and storage of the relay. A guide to the mechanical and electrical installation of the relay is provided, incorporating earthing recommendations. All external wiring connections to the relay are indicated.

P114D/EN VH Firmware and Service Manual Version History

History of all hardware and software releases for the product.

2. INTRODUCTION TO MiCOM

MiCOM is a comprehensive solution capable of meeting all electricity supply requirements. It comprises a range of components, systems and services from Schneider Electric.

Central to the MiCOM concept is flexibility.

MiCOM provides the ability to define an application solution and, through extensive communication capabilities, integrate it with your power supply control system.

The components within MiCOM are:

- P range protection relays;
- C range control products;
- M range measurement products for accurate metering and monitoring;
- S range versatile PC support and substation control packages.

MiCOM products include extensive facilities for recording information on the state and behavior of the power system using disturbance and fault records. They can also provide measurements of the system at regular intervals for a control center enabling remote monitoring and control to take place.

For up-to-date information on any MiCOM product, visit our website:

www.schneider-electric.com

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3. PRODUCT SCOPE

P114D is a 3-phase and earth fault non-directional overcurrent CT-powered and/or auxiliary voltage powered protection relay (depends on the ordering option. Refer to section 3.3)

The scope of P114D applications covers:

- industry and distribution MV networks;
- back-up protection in HV applications,

The relay protects one, two or three-phase applications against earth fault and phase-to-phase short-circuit faults. It was especially developed for compact MV switchboards with circuit breakers. Thanks to a built-in USB port, fault records and relay settings can be downloaded to a local PC.

Protection element settings are made via DIP switches on the front panel only.

Configuration of inputs and outputs is possible via DIP switches or MiCOM S1 setting software.

3.1 Key for the manual

There is one P114D hardware version with different nominal current ranges (ordering options: 1A or 5A).

Refer to the commercial publication for further information on the product features and application arrangements.

3.2 Functional overview

The P114D relay offers a wide variety of protection functions.
The protection features are summarized below:

PROTECTION FUNCTIONS OVERVIEW	
50/51	Two non-directional overcurrent stages are provided for each phase. The first stage (I>) may be set to Inverse Definite Minimum Time (IDMT) or Definite Time (DT); the second stage (I>>) may be set to DT only.
50N/51N	Two non-directional overcurrent stages are provided. The first stage (IN>) may be set to Inverse Definite Minimum Time (IDMT) or Definite Time (DT); the second stage (IN>>) may be set to DT only.

The P114D offers the following relay management functions in addition to the functions listed above.

- Up to 5 last Fault Records available via the USB port or rear communication port (RS485)
- Readout of actual settings available via the USB port or rear communication port (RS485)
- Control of CB via a rear communication port (RS485)
- Two binary inputs
- External trip function via binary input
- Up to 4 output contacts (ordering option)
- Energy output for CB low energy coil (ordering option)
- Energy output for Flag Indicator

- Protection settings via DIP switches
- 3 phase current inputs
- Earth fault current input

Application overview

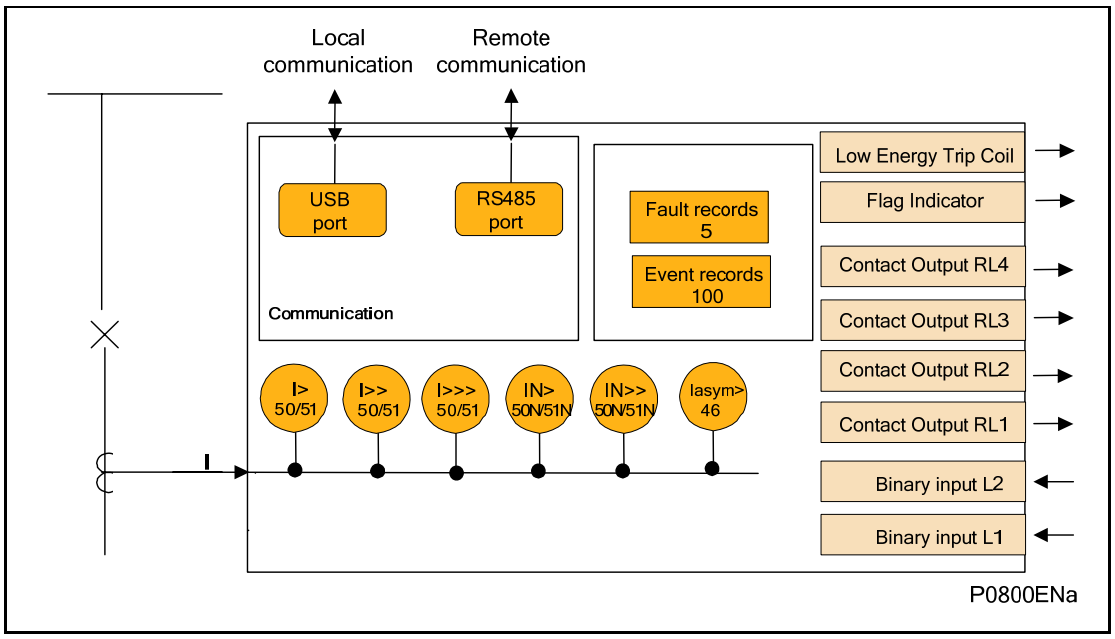

Figure 1: P114D functional diagram with all ordering options included

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3.3 Ordering options

Information Required with Order

Relay Type	P114D	753								1	
Number of contact outputs											
2 c/o contacts			0								
4 c/o contacts			1								
Energy output for CB trip											
Without				0							
Low energy CB coil: 24VDC, 0.1J				1							
Striker K1: 12VDC, 0.02J				2							
Type of case											
Wall mounting					0						
Flush mounting					1						
Rear communication port (RS485)											
Without						0					
RS485, Protocol Modbus RTU	(Vx and CT powering option only)					1					
RS485, Protocol IEC103	(Vx and CT powering option only)					2					
Auxiliary voltage Vx range **(Vx: common for auxiliary supply voltage and binary inputs)**											
Vx and CT powering;	Vx= 60-240VAC/60-250VDC						0				
Vx and CT powering;	Vx= 24-48AC/DC						1				
CT powering only;	Vx= 60-240VAC/60-250VDC						2				
CT powering only;	Vx= 24-48VAC/DC						3				
E/F nominal current, setting range **(Setting range is given for DT characteristic, for IDMT refer to technical data chapter)**											
Ien=1A, settings: 0.01 – 2 Ien								0			
Ien=1A, settings: 0.05 – 10 Ien								1			
Ien=1A, settings: 0.2 – 40 Ien								2			
Ien=5A, settings: 0.01 – 2 Ien								3			
Ien=5A, settings: 0.05 – 10 Ien								4			
Ien=5A, settings: 0.2 – 40 Ien								5			
Phase nominal current, setting range **(Setting range is given for DT characteristic, for IDMT refer to technical data chapter)**											
In=1A, settings: 0.2 – 39 In									0		
In=5A, settings: 0.2 – 39 In									1		
Settings File **(not compulsory)**											
Default											0
Customer-Specific											1

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TECHNICAL DATA

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

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Technical Data

Mechanical Specifications

Design
Wall mounting case or flush mounting case.

Enclosure Protection
EN 60529: 1991
IP 40 Protection for relay housing
IP 20 Protection for terminals.

Weight
approx. 1 kg

Terminals

AC Current Input Terminals

Threaded M3 screw-type plug-in terminals, with wire protection for conductor cross-section
(i) 0.2 - 6 mm^2 single-core
(ii) 0.2 - 4 mm^2 finely stranded

General Input/Output Terminals
For power supply, opto and contact inputs, output contacts and COM for rear communications.

Threaded M3 screw-type plug-in terminals, with wire protection for conductor cross-section
(i) 0.2 - 4 mm^2 single-core
(ii) 0.2 - 2.5 mm^2 finely stranded

Local communication

USB port

Rear Communications Port

EIA(RS)485 signal levels, two wire
Connections located on general purpose block, M3 screw
For screened twisted pair cable, multi-drop, 1000m max.
For Modbus RTU protocol.
Isolation to SELV level.

Ratings

AC Measuring Inputs
Nominal frequency of fundamental harmonic:
50 to 60 Hz
Operating range of fundamental harmonic::
40 to 70 Hz

Connection: refer to section 8 of P114D Installation chapter (P114D/EN IN)

Phase current
Nominal current (In): 1 or 5 A (ordering option)
True RMS measurement in range: 40 Hz - 1 kHz

Nominal burden per phase: < 0.3 VA at In
Thermal withstand:
continuous 3 In
for 10s: 30 In
for 1s; 100 In

Earth fault current
Nominal current (Ien): 1 or 5 A (ordering option)
True RMS measurement in range: 40 Hz - 70 Hz

Nominal burden per phase: < 0.3 VA at Ien
Thermal withstand:
continuous 3 Ien
for 10s: 30 Ien
for 1s; 100 Ien

Minimum level of current required for relay powering

Phase current: 0.2 In
Earth fault current: 0.2 Ien
Note: depends on connection on the terminals, earth fault input supplies P114D (connection: terminals 7 and 9) or does not supply P114D (connection: terminals 8 and 9) (refer to connection diagram)

Power Supply

Nominal Auxiliary Voltage Vx
Two ordering options:
(i) Vx: 24 to 48 Vdc, and 24 to 48 Vac (50/60 Hz)

(ii) Vx: 60 to 250 Vdc, and 60 to 240 Vac (50/60 Hz)

Operating Range
(i) 19 to 58 V (dc), 19 to 53 V (ac)
(ii) 48 to 300 V (dc), 48 to 265 V (ac)
With a tolerable ac ripple of up to 12% for a dc supply, per IEC 60255-11: 1979.

Nominal Burden

Auxiliary Power Supply:
Without energized outputs:
(i) 1.7 W (60-240 Vac/60-250 Vdc)
(ii) 2.5 W (24-48 Vac/dc).
Additions for energized binary inputs/outputs:
Per opto input: 0.03 W
Per energized output relay: 0.3 W

For 2 energized output relays and 2 energized inputs: 3 W (60-240 Vac/dc)

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Power-up Time for Auxiliary Supply Voltage only
Time to power up < 0.1 s.

Power Supply Voltage Interruption
IEC 60255-11: 1979
The relay will withstand a 20ms interruption in a DC auxiliary supply, without de-energizing.
EN 61000-4-11: 1997
The relay will withstand a 20ms interruption in an AC auxiliary supply, without de-energizing.

Analogue current inputs
Consumption per phase: In (Ien)=1 A or In(Ien) = 5 A:

Phase: 2.5 VA

Earth: 2.5 VA

Binary (Logic) Inputs

The logic inputs shall be powered with both DC and AC voltage as logic input control voltage

Logic input type: Optical isolated

Rated nominal voltage: same as Vx
Operating range: same as Vx
Withstand: 300 Vdc or 275 Vac

Nominal pick-up and reset thresholds:
(i) for DC:
Pick-up: approx. 50% minimum value of Auxiliary Voltage Operating Range,
Reset: approx. 45% minimum value of Auxiliary Voltage Operating Range.
(ii) for AC:
Pick-up: approx. 90% minimum value of Auxiliary Voltage Operating Range,
Reset: approx. 45% minimum value of Auxiliary Voltage Operating Range.

Recognition time (DC): <10ms.

Consumption of energy on Binary (logic) input:
(i) 24 to 48 V: 0.6 VA max
(ii) 60 to 240 Vac: 0.6VA max

Outputs

Impulse Output for the tripping coil (ordering option)

Trip energy:
- low energy tripping coil:
E ≥ 0.1J
Voltage: 24 Vdc - 0% to +10%

- striker:
E ≥ 0.02J
Voltage: 12 Vdc - 0% to +10%

Impulse Output for flag indicator or auxiliary relay

Trip energy: E ≥ 0.01J
Voltage: 24 Vdc - 0% to +10%

The tripping energy for the tripping coil/flag indicator is stored by a capacitor built into the protection relay. The capacitor is loaded by a current or binary input. The duration of the trip pulse is 50ms. The pause between the individual pulses depends on the impedance of the tripping coil/flag indicator coil and on the current level. The pulse lasts as long as the activation threshold is exceeded.

Output Contacts
General purpose relay outputs for signaling, tripping and alarming:
Rated voltage: 250 V
Continuous current: 5 A
Short-duration current: 25 A for 3 s
Making capacity: 150 A for 30 ms
Breaking capacity:
DC: 50 W resistive
DC: 25 W inductive (L/R = 40 ms)
AC: 1250 VA resistive (cos ϕ = unity)
AC: 1250 VA inductive (cos ϕ = 0.7)
Response to co mmand: < 10 ms
Durability:
Loaded contact: 10 000 operations minimum,
Unloaded contact: 100 000 operations minimum.

Environmental Conditions

Ambient Temperature Range
EN 60255-6: 1994
Operating temperature range:
-20°C to +60°C (or -4°F to +140°F).
Temporary permissible temperature -40°C to +85°C with additional errors
Storage and transit:
-25°C to +70°C (or -13°F to +158°F).

Ambient Humidity Range
IEC 60068-2-78: 2001:
56 days at 93% relative humidity and +40°C
EN 60068-2-30: 2005:
Damp heat cyclic, six (12 + 12) hour cycles, 93% RH, +25 to +55°C

Type Tests

Insulation Resistance
EN 60255-5:2001
Insulation resistance > 100 MΩ at 500 Vdc (Using only electronic/brushless insulation tester).

Creepage Distances and Clearances
EN 60255-27:2005
Pollution degree 2,
Overvoltage category III,
Impulse test voltage 5 kV.

High Voltage (Dielectric) Withstand
EN 60255-27:2005, 2 kV rms AC, 1 minute:
Between all case terminals connected together and the case earth.
Between all terminals of independent circuits with terminals on each independent circuit connected together.

Impulse Voltage Withstand Test
EN 60255-27: 2005,
Front time: 1.2 µs, Time to half-value: 50 µs,
Peak value: 5 kV,
Source Characteristics: 500 Ohm, 0.5 J.
Common and differential mode - power supply, terminal block (excluding RS485), opto inputs, relays.

Electromagnetic Compatibility (EMC)

1 MHz Burst High Frequency Disturbance Test
IEC 60255-22-1: 2005, Class III,
Common-mode test voltage: 2.5 kV,
Differential test voltage: 1.0 kV,
Test duration: 2 s, Source impedance: 200 Ω

Immunity to Electrostatic Discharge
IEC 60255-22-2: 1996, Class 3,
8 kV discharge in air to all communication ports.
6 kV point contact discharge to any part of the front of the product.

Electrical Fast Transient or Burst Requirements
EN 60255-22-4: 2002. Test severity Class III:
Amplitude: 2 kV, burst frequency 5 kHz (Class III),

Surge Immunity Test
EN60255-22-5:2002; EN 61000-4-5: 2006
Level 3,
Time to half-value: 1.2/50 µs,
Amplitude: 2kV between all groups and case earth,
Amplitude: 1kV between terminals of each group.

Immunity to Radiated Electromagnetic Energy
EN 60255-22-3: 2000, Class III:
Test field strength, frequency band 80 to 1000 MHz:
10 V/m,
Test using AM: 1 kHz / 80%,

Radiated Immunity from Digital Radio Telephones
Per EN 60255-22-3:2000
10 V/m, 900 MHz 100% AM, 200 Hz/50% square wave

Immunity to Conducted Disturbances Induced by Radio Frequency Fields
EN 61000-4-6: 1996, Level 3,
Disturbing test voltage: 10 V, 150 Hz to 80 MHz, 80% AM, 1 kHz

Power Frequency Magnetic Field Immunity
IEC 61000-4-8: 1994, Level 4,
30 A/m applied continuously,
300 A/m applied for 3s.

Conducted Emissions
EN 55022: 2006
0.15 - 0.5 MHz, 79 dBµV (quasi peak)
66 dBµV (average)
0.5 - 30 MHz, 73 dBµV (quasi peak)
60 dBµV (average).

Radiated Emissions
EN 55022: 2006
30 - 230 MHz, 40 dBµV/m at 10 m measurement distance
230 - 1 GHz, 47 dBµV/m at 10 m measurement distance.

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EU Directives

EMC Compliance
2004/108/EC:
Compliance to the European Commission Directive on EMC is claimed. Product Specific Standards were used to establish conformity:
EN50263: 2000

Product Safety
2006/95/EC:
Compliance with European Commission Low Voltage Directive.
Compliance is demonstrated by reference to product specific standards:
EN60255-27: 2005
EN60255-5: 2001

Mechanical Robustness

Vibration Test
EN 60255-21-1: 1996
Response Class 1
Endurance Class 1

Shock and Bump
EN 60255-21-2: 1996
Shock response Class 1
Shock withstand Class 1
Bump Class 1

Protection Functions

Note:

1) All settings and measurements are given as a multiple of the In (Ien) current value (ordering option)

2) The minimum tripping time when switched on to a fault is subject to the fault current level (see Figure 1). Figure 1 diagram shows the time correction under worst conditions such as inception of fault from 0 A current, ageing, temperature.

Three Phase Overcurrent Protection

Accuracy
Note: all data below are given for inception of fault from current above 0.2 In (Ien) at least in 1 phase conditions or if P114D is powered from Vx auxiliary voltage supply.
If the pre-fault current is below 0.2 In (Ien) in all phases and no Vx on terminals 11 -12 additional time correction should be taken into account (refer to Figure 1)

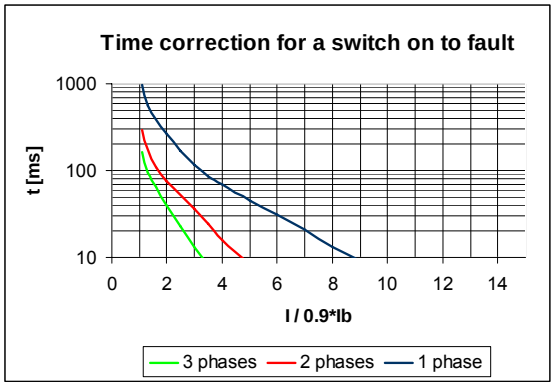


Figure 1. Time correction for switch on to fault

The minimum operation time, if P114D is supplied from Vx, is less than 35 ms

I>,:
(i) Pick-up: ±5%
in the temperature range 0°C to +60°C
(ii) Pick-up: ±7.5%
in the temperature range -40°C to +85°C

Drop-off: 0.95 x setting ±5%
Minimum IDMT level:
1.05 x setting ±5%
IDMT curve: ±10% or 30 ms whichever is greater
DT operation: ±2% or 30 ms, whichever is greater
DT reset: ±10% or 30 ms, whichever is greater

I>>:
Pick-up: ±5%
in the temperature range 0°C to +60°C
(ii) Pick-up: ±15%
in the temperature range -40°C to +85°C

Drop-off: 0.95 x setting ±5%
DT operation: ±2% or 30 ms, whichever is greater
DT reset: ±10% or 30 ms, whichever is greater

Earth Fault Protection

Earth Fault IN>, IN>>

Pick-up:

(i) Setting ±5%
in the temperature range 0°C to +60°C
(ii) Pick-up: ±7.5%
in the temperature range -40°C to +85°C
DT operation:
±2% or 30 ms whichever is greater
DT reset: ±10% or 30 ms, whichever is greater

Measurements and Recording Facilities

Measurements stored in fault records
Phase current
For current: 0.2 to 4 In:
Accuracy: ±5% of reading

For current: 4 to 20 In:
Accuracy: ±10% of reading

Earth fault current

For current: minimum setting value to 0.2 Ien:
Accuracy: ±10% of reading

For current: 0.2 to 2 Ien:
Accuracy: ±5% of reading

For current: 2 Ien to maximum setting value:
Accuracy: ±10% of reading

Communications

USB:

USB port for local communications with a PC
Protocol: MODBUS RTU

Virtual COM for USB should be set as follows:

Address: 1

Baud Rate:
38400 bits/s

Co mms. Mode:
Data Bit: 8
Stop bit: 1
Parity: none

RS485:
Protocol (ordering option):
- MODBUS RTU
- IEC 103

Physical Link: Copper; RS485 half duplex

Co mms. Mode (MODBUS RTU protocol only):
Data Bit: 8
Stop bit: 1
Parity: none

Address: 1-254

Baud Rate:
4800 bits/s
9600 bits/s
19200 bits/s
38400 bits/s

It is possible to download settings, fault records and events via the communication port.

Configuration of inputs and outputs via communication port is possible if appropriate DIP switch is set for this function (refer to Settings chapter of this manual).

Settings, Measurements and Records List

TD

Settings

Phase Overcurrent

Stages:
I> Function:
DT, TD time delay:
0.025s to 64s;
- 0.025s to 1.6s, steps: 0.025s,
- 1.5s to 7.8s, steps: 0.1s
- 7.5s to 39s, steps: 0.5s
- 1s to 64s, steps: 1s

TMS:
0.025s to 1.6s: steps: 0.025s

Type of characteristic:
(i) DT
(ii) IEC S Inverse
(iii) IEC V Inverse
(iv) IEC E Inverse
(v) UK LT Inverse
(vi) RI
(vii) UK ST Inverse
(viii) UK Rectifier Inverse
(ix) IEEE M Inverse
(x) IEEE V Inverse
(xi) IEEE E Inverse
(xii) US CO2
(xiii) US CO8

The mathematical formulae and curves for the twelve Inverse Time characteristics available with the P114D are presented in the OP ("Operation") chapter of this manual

IDMT accuracy is ensured up to 20 x In

Reset time of IDMT IEEE, US, IEC stages is settable:
- Instantaneous reset
- IDMT delayed according to the mathematical formulae presented in the OP ("Operation") chapter of this manual. The reset time setting is common for I> and IN

I> Current Set:
0.2 to 4.7 In:
- 0.2 to 1.7 In, steps: 0.05 In,

- 1.7 to 4.7 In, steps: 0.1 In
  or disable (OFF)

I>> Function:

Type of characteristic: DT
DT time delay:
0.00 s to 3.7 s;
- 0.00 s to 0.62 s, steps: 0.02 s,
- 0.6 s to 3.7 s, steps: 0.1 s

I>> Current Set:
0.5 to 39 In:
- 0.5 to 8 In, steps: 0.25 In,
- 9 to 39 In, steps: 1 In
  or disable (OFF)

Ground Overcurrent (Earth Fault)

Stages:
IN> Function:

DT, TD time delay:
0.025 s to 64 s;
- 0.025s to 1.6 s, steps: 0.025 s,
- 1.5s to 7.8 s, steps: 0.1 s
- 7.5s to 39 s, steps: 0.5 s
- 1s to 64 s, steps: 1 s

TMS: 0.025s to 1.6s: steps: 0.025s

Type of characteristic:
(i) DT
(ii) IEC S Inverse
(iii) IEC V Inverse
(iv) IEC E Inverse
(v) UK LT Inverse
(vi) RI
(xiv) UK ST Inverse
(xv) UK Rectifier Inverse
(xvi) IEEE M Inverse
(xvii) IEEE V Inverse
(xviii) IEEE E Inverse
(xix) US CO2
(xx) US CO8

The mathematical formulae and curves for the twelve Inverse Time characteristics available with the P114D are presented in the OP ("Operation") chapter of this manual

IDMT accuracy is ensured up to 20 x Ien

Reset time of IDMT IEEE, US, IEC stages is settable:
- Instantaneous reset
- IDMT delayed according to the mathematical formulae presented in the OP ("Operation") chapter. The reset time setting is common for I> and IN

IN> Current Set (ordering option):
(i) 0.01 to 1,84 Ien:
- 0.01 to 0.31 Ien, steps: 0.01 Ien,
- 0.3 to 1.84 Ien, steps: 0.05 Ien
  or disable (OFF)

(ii) 0.05 to 9.2 Ien:
- 0.05 to 1.55 Ien, steps: 0.05 Ien,
- 1.5 to 9.2 Ien, steps: 0.25 Ien
  or disable (OFF)

(iii) 0.2 to 4.7 Ien:
- 0.2 to 1.7 Ien, steps: 0.05 Ien,
- 1.5 to 4.7 Ien, steps: 0.1 Ien
  or disable (OFF)

IN>> Function:

Type of characteristic:
DT

DT time delay:
0.00 s to 7.8 s;
- 0.00 s to 1.55 s, steps: 0.05 s,
- 1.6 s to 7.8 s, steps: 0.2 s

I>> Current Set:
(i) 0.01 to 2,1 Ien:
- 0.01 to 0.61 Ien, steps: 0.02 Ien,
- 0.6 to 2.1 Ien, steps: 0.05 Ien
  or disable (OFF)

(ii) 0.05 to 10.5 Ien:
- 0.05 to 3.05 Ien, steps: 0.1 Ien,
- 3.0 to 10.5 Ien, steps: 0.25 Ien
  or disable (OFF)

(iii) 0.5 to 39 Ien:
- 0.5 to 8 Ien, steps: 0.25 Ien,
- 9 to 39 Ien, steps: 1 Ien
  or disable (OFF)

Minimum earth fault operating current: 0.2 Ien

Measurements List

Measurements

IA, IB, IC, IN

Fault Record Proforma

The following data is recorded for any relevant elements in operation during a fault, and can be downloaded via MiCOM S1 software (last 5 fault records)

Event Text
Phase Overcurrent
Trip I>
Trip I>>
Trip IN>
Trip IN>>
AUX
Event Value
Fault Time
Per phase record of fault current value:
IA, IB, IC
IN

GS

GETTING STARTED

Date: **20th February 2008**

Hardware Suffix: **A**

Software Version: **1A**

Connection Diagrams: **10P114D01**

GS

CONTENTS

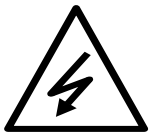
GS

FIGURES

GS

1. GETTING STARTED

Before carrying out any work on the equipment, the user should be familiar with the contents of the Safety Guide SFTY/4L M/E11 or later issue, OR the safety and technical data section of the technical manual and also the ratings on the equipment rating label.



For safety reasons, no work must be carried out on the P114D until all power sources to the unit have been disconnected.

1.1 User interfaces and menu structure

The settings and functions on the MiCOM P114D protection relay can be accessed from the front panel by using DIP switches only. Information on these functions is given in this section to describe basic functionality of the relay.

1.2 Introduction to the relay

1.2.1 Front panel

The front panel of the relay is shown in Figure 1.

The front panel of the relay includes DIP-Switches, six LEDs and a USB port for local communication.

1.2.1.1 Indications

Fixed Function

The 6 fixed function LEDs below the DIP switches on the front panel are used to indicate the following conditions:

Healthy – Powering of microprocessor and no hardware problems detected (green LED)

I> – Start (flashing) and trip (constant lit) of the first phase overcurrent stage

I>> - Start (flashing) and trip (constant lit) of the second phase overcurrent stage

IN> – Start (flashing) and trip (constant lit) of the first e/f overcurrent stage

IN>> - Start (flashing) and trip (constant lit) of the second e/f overcurrent stage

AUX – External Trip via binary input

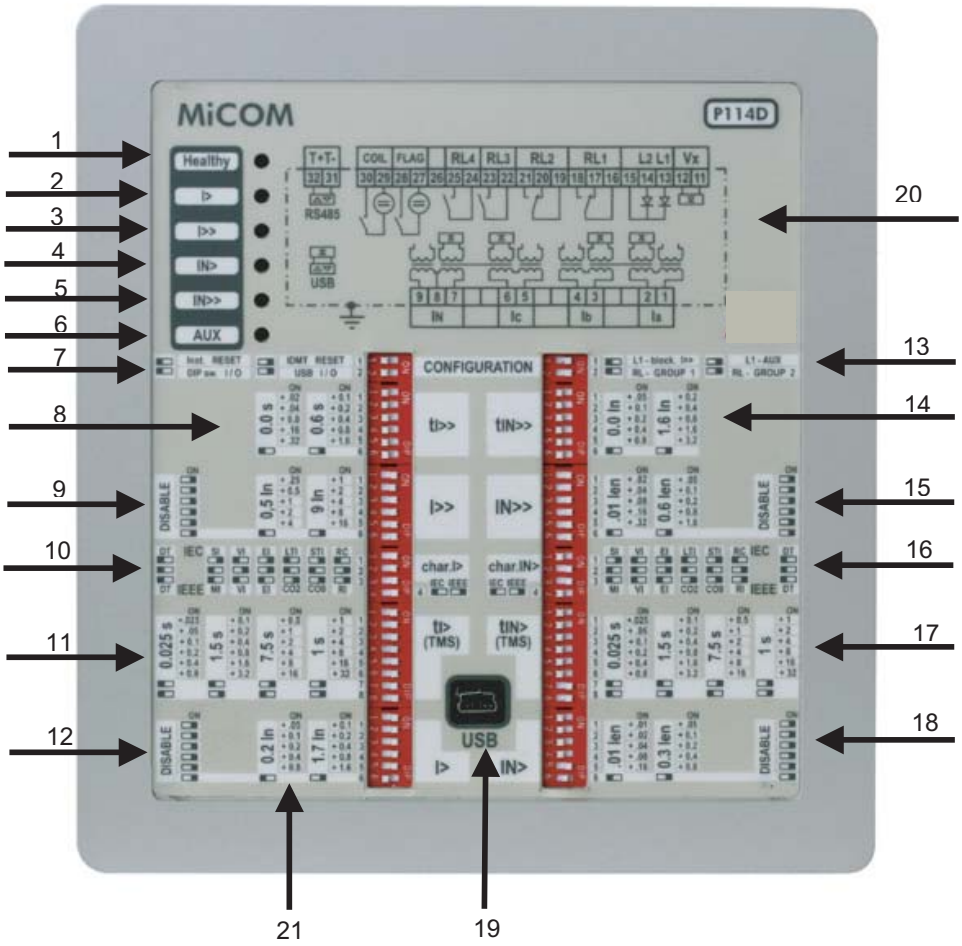
External indication of a fault can be done via an external Flag Indication (available in Schneider Electric offer: FI10) which should be connected to terminals 27-28.

1.3 Relay connection and power-up

The relay can be powered from the following sources:

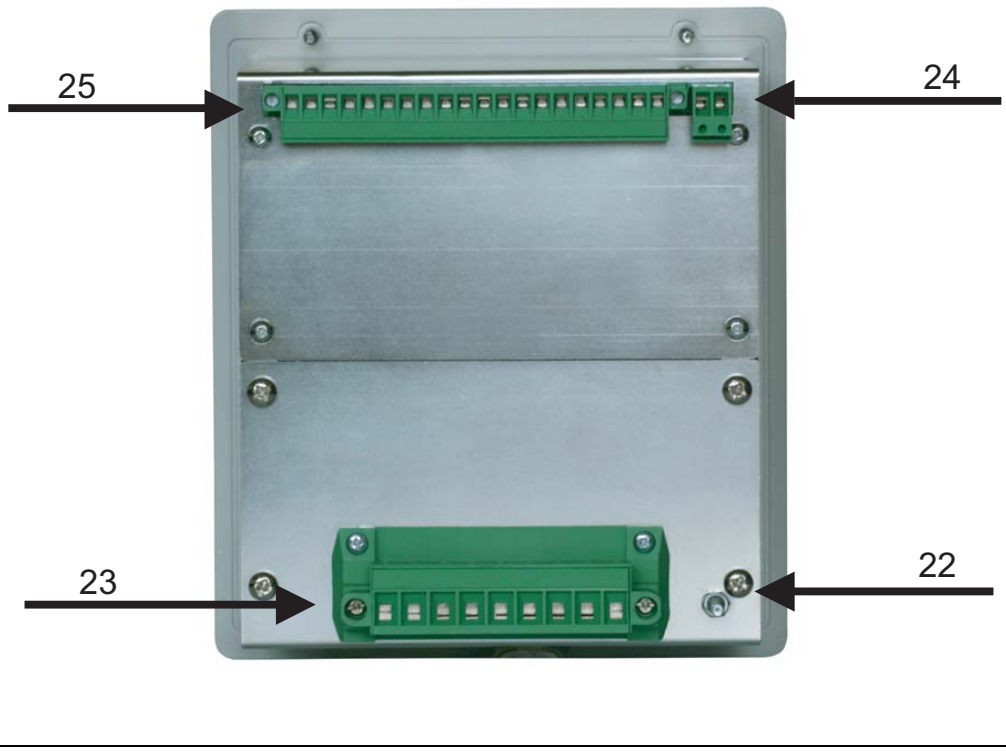
- Current input phase L1 (A)
- Current input phase L2 (B)
- Current input phase L3 (C)
- E/F Current input (N) (depends on connection on the terminals)
- Auxiliary voltage Vx (11-12 terminals)
- USB port

GS



1 - Green “Healthy” LED.
2 - Red “I>” LED. Start (flashing) and trip (constant lit) of the first phase overcurrent stage
3 - Red “I>>” LED. Start (flashing) and trip (constant lit) of the second phase overcurrent stage
4 - Red “IN>” LED. Start (flashing) and trip (constant lit) of the first earth fault overcurrent stage
5 - Red “IN>>” LED. Start (flashing) and trip (constant lit) of the second earth fault overcurrent stage
6 - Red “AUX” LED. Trip of the auxiliary function (external trip)
7 - Switch Block 1 Number: 1-2: Configuration. IDMT reset configuration (1) and I/O configuration (2)
8 - Switch Block 2 Number: 1-6: time delay setting for the second stage of overcurrent protection (tI>>)
9 - Switch Block 3 Number: 1-6: current stage for the second stage of overcurrent protection (I>>)
10 -Switch Block 4 Number: 1-4: the type of time delay characteristic for the first stage of overcurrent protection (tI>)
11 -Switch Block 5 Number: 1-8: time delay setting for the first stage of overcurrent protection (I>)
12 -Switch Block 6 Number: 1-6: current stage for the first stage of overcurrent protection (I>)
13 -Switch Block 7 Number: 1-2: Configuration. Input configuration (1) and Output configuration (2)
14 -Switch Block 8 Number: 1-6: time delay setting for the second stage of e/f protection (tIN>>)
15 -Switch Block 9 Number: 1-6: current stage for the second stage of e/f protection (IN>>)
16 -Switch Block 4 Number: 1-4: the type of time delay characteristic for the first stage of e/f protection (tNI>)
17 -Switch Block 5 Number: 1-8: time delay setting for the first stage of e/f protection (IN>)
18 -Switch Block 6 Number: 1-6: current stage for the first stage of e/f protection (IN>)
19 -USB port for local connection
20 -Connection Diagram
21 -Description of DIP switches for easy setting without manual description

Figure 1: P114D front panel



22 -PCT Protective (Earth) Conductor terminal
23 -the 1st terminals segment: phase and e/f current inputs
24 -the 2nd terminals segment: RS485
25 -the 3rd terminals segment: Auxiliary voltage supply, Binary inputs, Binary outputs, Flag indicator energy output, Low energy trip coil,

Figure 2: Rear view of the P114D

1.3.1 Auxiliary Supply Voltage (Vx) connection

Before applying the supply voltage to the relay, check that the rated nominal ac or dc voltage is appropriate for the application and that it will be connected to the correct terminals (11 and 12). The relay serial number, current rating, and power rating information can be viewed on the upper side of compact case. The ac or dc supply voltage must be within the range specified in the table below, for the appropriate nominal rating of the equipment:

Nominal range of auxiliary voltage Vx	Operative dc Range	Operative ac Range
24 to 48 Vac/dc	19 to 58 Vdc	19 to 53 Vac
60 to 250 Vdc and 60 to 240 Vac	48 to 300 Vdc	48 to 265 Vac

Once the ratings have been verified for the application, connect the equipment to an external power source capable of delivering the requirements specified on the label, to perform the relay familiarization procedures. Please refer to the wiring diagrams in the Installation section for complete installation details ensuring that the correct polarities are observed in the case of dc supply.

Note: the label specifies Vx for both the P114D supply input and logic input.

1.3.2 Current inputs

The measuring current inputs of the P114D should be connected to the secondary wires of the power system CTs as shown in the connection diagrams in “8. External Connection Diagram” of P114D Installation chapter P114D/EN IN.

The CT types which can be connected to the P114D’s current input terminals are shown in section 3 of Applications chapter P114D/EN AP.

1.3.3 Tripping coil output (ordering option)

Terminals 29 and 30 (3rd block terminal) are used for the connection of the CB's low energy tripping coil or striker (ordering option)

The trip energy is provided by capacitors built into the P114D. The trip command is constructed from a 50ms pulse and its repetition depends on the tripping coil's impedance and on the current value. Repetition is applied until the current criteria are reset.

The voltage on terminals 29 and 30 depends on the ordering option:

- low energy tripping coil: greater than 24 Vdc. The trip energy is greater than 0.1 J.
- striker K1: greater than 12 Vdc. The trip energy is greater than 0.02 J.

1.3.4 Flag indicator output

Terminals 27 and 28 (3rd block terminal) are used for the connection of a flag indicator.

The flag indicator can be used for signaling. Output from a relay is supplied from a built-in P114D capacitor different from the trip coil output (terminals 29 and 30).

The trip command is a 50 ms pulse, repetition depends on the external relay's impedance (flag indicator) and on the current value. Repetition continues until the current criteria are reset.

The voltage on terminals 27 and 28 is greater than 24 Vdc. The trip energy is greater than 0.01J.

1.3.5 Earthing

Terminal “PCT” is the Protective (Earth) Conductor Terminal which must be permanently connected for safety reasons (refer to Figure 2).

1.3.6 Output contacts

P114D has up to 4 output contacts depending on ordering option.

P114D is delivered with following default factory settings for outputs:

- “Output GROUP 1” output setting group: DIP Switch Block 7 Number 2 (“**DIP I/O**” / “USB I/O”) **OFF** and Switch Block 1 Number 2 (“**RL – GROUP 1**” / “RL – GROUP 2”) **OFF**

“Output GROUP 1” output setting group has the following settings:

- output RL1 (N/O: 16-17, N/C: terminals 16-18) is mapped to Any trip (tI>, tI>>, tIN>, tIN>, AUX) with a 0.4s pulse, without latching the output
- output RL2 (N/O: 19-20, N/C: terminals 19-21) is mapped to Any trip (tI>, tI>>, tIN>, tIN>, AUX), without latching the output
- output RL3 (N/O: terminals 22-23) (optional) is mapped to Any trip (tI>, tI>>, tIN>, tIN>, AUX), with latching via fixed time (factory setting: 3 days). Latching can be reset in any time via Binary Input set to “Reset latched outputs” function
- output RL4 (N/O: terminals 24-25) (optional) is mapped to start of I>> stage

To change output configuration refer to section 1.2.3 of chapter P114D/EN ST (“Settings”).

The output connection diagram is shown in section 8 of chapter P114D/EN IN (“Installation”).

1.3.7 Opto logic inputs

P114D has 2 logic inputs: L1 (terminals 13-15) and L2 (terminals 14-15)

P114D is delivered with the following default factory settings for inputs:

- "Input GROUP 2" input setting group: DIP Switch Block 1 Number 2 **("DIP I/O**" / "USB I/O") **OFF** and DIP Switch Block 7 Number 1 ("L1 – block I>>" / **"L1 – AUX**") **ON**,
- "Input GROUP 2" input setting group has the following settings:
  - input L1 is mapped to AUX function (trip via binary input)
  - input L2 is configured for reset of latched LEDs and outputs

To change the inputs' configuration refer to section 1.2.3 of chapter P114D/EN ST ("Settings").

The input connection diagram is shown in section 8 of chapter P114D/EN IN ("Installation").

1.4 Introduction to the user interfaces and settings options

The relay has a USB user interface for the MiCOM S1 software.

By means of this interface it is possible to download the setting values, last 5 fault records and make a general configuration of P114D (communication parameters, I/O configuration if DIP switch activates this function).

Note: After connection to USB port the "Healthy" LED is lit. If the LED is not lit refer to P114D/EN TS ("Troubleshooting") chapter

GS

ST

SETTINGS

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

ST

CONTENTS

1. SETTINGS

The relay is supplied with a factory-set configuration of default settings. All current settings refer to nominal current (ordering option: 1A or 5A). The nominal current can be defined separately for phase (In) and earth (Ien) current in ordering process (ordering hardware option).

Protection settings

The protection functions of the P114D can be configured to the system and application by means of DIP switches.

MiCOM S1 can be used to download protection setting values via the relay's USB port.

The setting software cannot be used to configure the protection settings (settings of protection elements).

General configuration settings

I/O configuration can be done via DIP switches on the front panel of relay or via the setting software.

On the front panel: Switch Block 1 Number 2 (option: “DIP I/O” / “USB I/O”) allows the selection of the configuration setting. The position of this switch clearly indicates which mode of configuration is currently active: via DIP switches (“DIP I/O”) or via setting software (“USB I/O”).

The configuration of each binary input and each binary output is grouped in the three setting groups:

Binary Input configuration has three setting groups:

- “Input GROUP 1”: Switch Block 1 Number 2 (“**DIP I/O**” / “USB I/O”) in position: **OFF** (“DIP I/O”) and Switch Block 7 Number 1 (“**L1 - blocking of I>>**” / (“L1 – AUX”) in position **OFF** (“L1 - blocking of I>>”)
- “Input GROUP 2”: Switch Block 1 Number 2 (“**DIP I/O**” / “USB I/O”) in position: OFF (“DIP I/O”) and Switch Block 7 Number 1 in position: ON (“L1 – AUX”)
- “Input GROUP 3” (default settings which can be changed via MiCOM S1: Switch Block 1 Number 2 (“DIP I/O” / “**USB I/O**”) in position: **ON** (“USB I/O”) and Switch Block 7 Number 1 (“L1 - blocking of I>>” / “L1 – AUX”) in any position.

Binary Output configuration has three setting groups:

- “Output GROUP 1”: Switch Block 1 Number 2 (“**DIP I/O**” / “USB I/O”) in position: **OFF** (“DIP I/O”) and Switch Block 7 Number 2 (“**RL – GROUP 1**” / RL – GROUP 2”) in position **OFF** (“RL – GROUP 1”)
- “Output GROUP 2”: Switch Block 1 Number 2 (“**DIP I/O**” / “USB I/O”) in position: **OFF** (“DIP I/O”) and Switch Block 7 Number 2 (“RL – GROUP 1” / **RL – GROUP 2**”) in position: **ON** (“RL – Group 2”)
- “Output GROUP 3” default settings which can be changed via MiCOM S1: Switch Block 1 Number 2 (“DIP I/O” / “**USB I/O**”) in position: **ON** (“USB I/O”) and Switch Block 7 Number 1 (“RL – GROUP 1” / RL – GROUP 2”) in any position.

MiCOM S1 can be used to download the I/O configuration.

Note 1: For “Output GROUP 3” group and “Input GROUP 3” group it is possible to change settings only via the MiCOM S1 software (USB or RS485 port).

Note 2: If “Input GROUP 3” group is selected, the outputs are configured to “Output GROUP 3” group because Switch Block 1 Number 2 (“DIP I/O” / “**USB I/O**”) is in **ON** position (“USB I/O”).

1.1 Relay settings configuration

A description of DIP switch settings is given on the front panel.

The following protection parameters can be set by means of DIP switches:

Description	Switch Block	Switch Number	Setting parameter	Setting range	Unit
Config.	1	1	Time Delay Reset for IDMT character.	- OFF: instantaneous reset ("Inst. Reset") - ON: IDMT reset ("IDMT reset")	[-]
		2	I/O configuration	- OFF: DIP switches I/O configuration ("DIP I/O") - ON: MiCOM S1 I/O configuration ("USB I/O")	[-]
tI>>	2	1-6	Time delay of I>> element	0.00 to 3.7: - 0.00 to 0.62, step: 0.02, - 0.6 to 3.7, step: 0.1	[s]
I>>	3	1-6	Current threshold of I>> element	0.5 to 39: - 0.5 to 8, step: 0.25 - 9 to 39, step: 1 or disable (all switch numbers in ON position)	[In]
CHAR.	4	1-4	Type of characteristic for 1st stage (I>) of overcurrent element	DT IEC S Inverse IEC V Inverse IEC E Inverse UK LT InverseR UK ST Inverse UK Rectifier Inverse IEEE M Inverse IEEE V Inverse IEEE E Inverse US CO2 US CO8	[-]
tI> / TMS / TD	5	1-8	I> element: Time delay of DT or TMS /TD factor of IDMT	0.025 to 64; - 0.025 to 1.6, step: 0.025, - 1.5 to 7.8, step: 0.1 - 7.5 to 39, step: 0.5 - 1 to 64, step: 1	[s] / [-] / [-]
I>	6	1-6	Current threshold of I> element	0.2 to 4.7: - 0.2 to 1.7, step: 0.05, - 1.7 to 4.7, step: 0.1, or disable (all switch numbers in ON position)	[In]

ST

ST

Description	Switch Block	Switch Number	Setting parameter	Setting range	Unit
I/O config.	7	1	Inputs configuration active if Switch Block 1 Number 2 is in OFF ("DIP I/O")	- OFF: "Input GROUP 1" ("L1 - blocking of I>>") - ON: "Input GROUP 2" (" L1 - AUX")	[-]
		2	Outputs configuration active if Switch Block 1, Number 2 is in OFF ("DIP I/O")	- OFF: "Output GROUP 1" ("RL – Group 1") - ON: "Output GROUP 2" ("RL – Group 2")	[-]
tIN>>	8	1-6	Time delay of IN>> element	0.00 to 7.8: - 0.00 to 1.55, step: 0.05, - 1.6 to 7.8, step: 0.2	[s]
IN>>	9	1-6	Current threshold of IN>> element	Ordering option: (i) 0.01 to 2.1: - 0.01 to 0.61, step: 0.02, - 0.6 to 2.1, step: 0.05, or disable (all switch numbers in ON position) (ii) 0.05 to 10.5: - 0.05 to 3.05, step: 0.1, - 3.0 to 10.5, step: 0.25 or disable (all switch numbers in ON position) (iii) 0.5 to 39: - 0.5 to 8, step: 0.25, - 9 to 39, step: 1 or disable (all switch numbers in ON position)	[Ien]
CHAR.	10	1-4	Type of characteristic for 1st stage (IN>) of e/f element	DT IEC S Inverse IEC V Inverse IEC E Inverse UK LT Inverse UK ST Inverse UK Rectifier Inverse IEEE M Inverse IEEE V Inverse IEEE E Inverse US CO2 US CO8	[-]

Description	Switch Block	Switch Number	Setting parameter	Setting range	Unit
tIN> /TMS /TD	11	1-8	IN> element: Time delay of DT or TMS /TD factor of IDMT	0.025 to 64; - 0.025 to 1.6, step: 0.025, - 1.5 to 7.8, step: 0.1 - 7.5 to 39, step: 0.5 - 1 to 64, step: 1	[s]
IN>	12	1-6	Current threshold of IN> element	Ordering option: (i) 0.01 to 1.84: - 0.01 to 0.31, step: 0.01, - 0.3 to 1.84, step: 0.05, or disable (all switch numbers in ON position) (ii) 0.05 to 9.2: - 0.05 to 1.55, step: 0.05, - 1.5 to 9.2, step: 0.25 or disable (all switch numbers in ON position) (iii) 0.2 to 4.7: - 0.2 to 1.7, step: 0.05, - 1.5 to 4.7, step: 0.1 or disable (all switch numbers in ON position	[Ien]

Table 1: Setting parameters via DIP switches

1.2 Protection settings

The protection settings include all the following items that become active once enabled by DIP switches

1.2.1 Phase overcurrent protection

The phase overcurrent protection included in the P114D relay provides two stage (I> I>>) non-directional three-phase overcurrent protection with independent time delay characteristics. All overcurrent settings apply to all three phases but are independent for each of the two stages.
All settings refer to the nominal current In (ordering option: 1A or 5A)

1.2.1.1 First overcurrent protection stage I>

The first overcurrent stage (I>) has time-delayed characteristics which are selectable (DIP Switch Block 4: “CHAR.”) between:

- Group 1 (IEC & UK). Switch Block 4 Number 4 set to OFF:
    - DT: Definite time characteristic
    - SI: Standard Inverse Time Characteristic (IEC)
    - VI: Very Inverse Time Characteristic (IEC)
    - EI: Extremely Inverse Time Characteristic (IEC)

- o LTI: UK Long Time Inverse Characteristic
- o STI: Schneider Electric Short Time Inverse Characteristic
- o RC: UK Rectifier Characteristic

- Group 2 (IEEE & US). DIP Switch Block 4 Number 4 set to ON:
  - o MI: Medium Inverse Time Characteristic (IEEE)
  - o VI: Very Inverse Time Characteristic (IEEE)
  - o EI: Extremely Inverse Time Characteristic (IEEE)
  - o CO2: US Short Time Inverse Characteristic
  - o CO8: US Inverse Characteristic
  - o RI: Electromechanical Inverse Characteristic

Further details are given in the “Operation” chapter of this manual (P114D/EN OP)

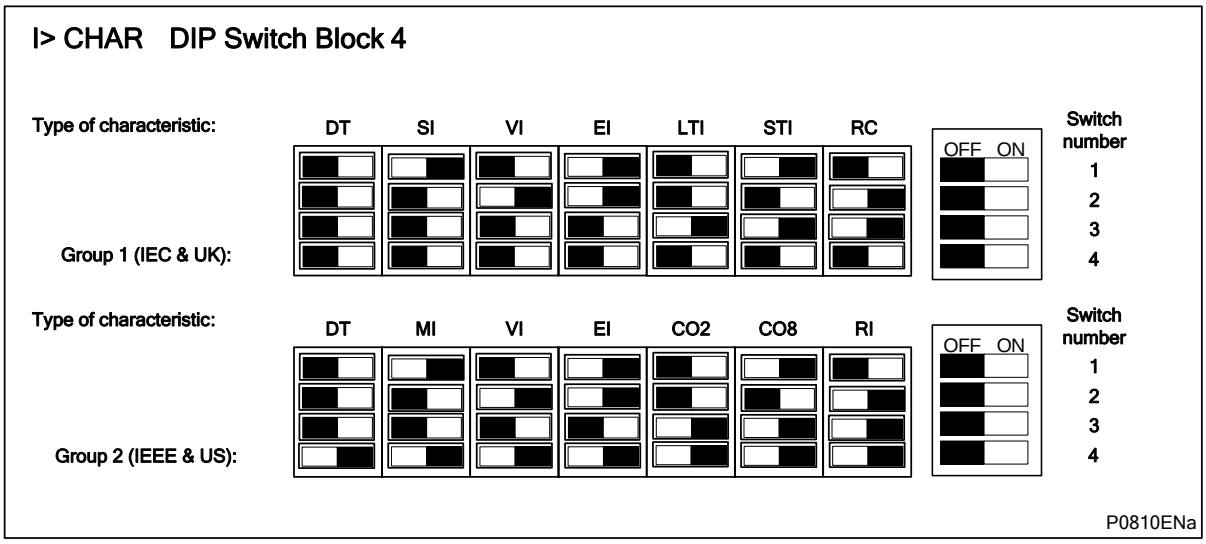


Table 2: Time characteristic setting for the first stage element I>

ANSI (MI, VI, EI) and IEC (SI, VI, EI) characteristics can be set with instantaneous reset (for current below current threshold) or with IDMT reset time delay.
The setting of the reset mode is made via DIP Switch Block 1 Number 1 (Table 3).
If Switch Number 1 (“**Inst. reset**” / “IDMT reset”) is set to **OFF**, the reset of the time delay for current below overcurrent stage is instantaneous, if Switch Number 1 (“Inst. reset” / “**IDMT reset**”) is set to **ON,** the reset of I> time delay is with IDMT time (reset time depends on the current below the current threshold)

This reset setting is common to both I> and IN> characteristics

Further details are given in the “Operation” chapter of this manual (P114D/EN OP).

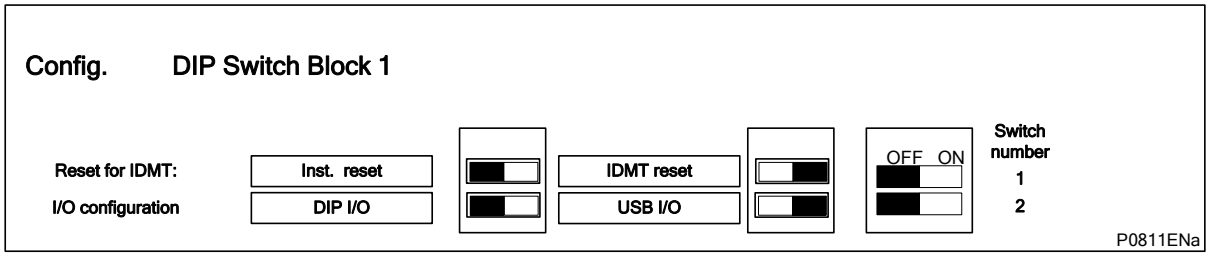


Table3: Resetting mode of the first stage overcurrent time delay for IEEE and IEC characteristics (Reset of IDMT)

First stage current threshold (I>) setting is shown in Table 4.

For example:

"I>" should be set to 1.25In

1) "Setting range" (Switch number: 6) should be set in OFF position: 1.25 In is in the range 0.2 – 1.7 In.

2) The minimal value for this setting range is 0.2In so we have to calculate:

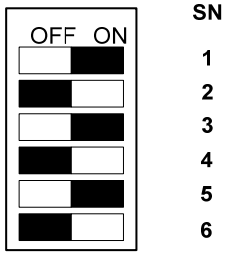
   1.25 In - 0.2 In= 1.05 In.

3) It is necessary to add (change position to ON): 0.8 In (SN:5) + 0.2 In (SN:3) + 0.05 In (SN:1) = 1.05 In

4) The setting is equal to: the minimal (MIN) value of setting range + added (ON) values = 0.2 In (MIN) + 0.8 In (SN:5)+ 0.2 In (SN:3)+ 0.05 In (SN:1)= 1.25 In

The remaining switches should be in the OFF position: 0.1 In (SN:2), 0.4 In (SN:4) and Setting group (OFF)

5) The position of the "I>" DIP switch should be as follows:



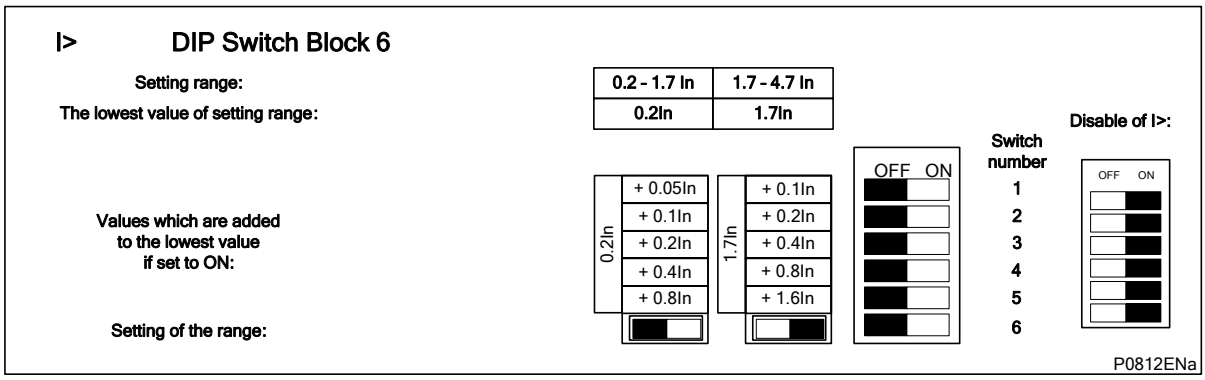


Table 4: Current threshold setting for the first overcurrent stage (I>)

The time delay setting is shown in Table 5.

For example:

Time delay of "tI>" element should be set to 9.5s

1) "Setting range" (Switch Numbers: 7 and 8) should be set as follows::

   - Switch Number: 7 OFF position
   - Switch Number: 8 ON position

   because 9.5s is in the range: 7.5 – 39 s.

2) The minimal value for this setting range is 7.5 s so we have to calculate: 9.5 s - 7.5 s = 2.0 s.

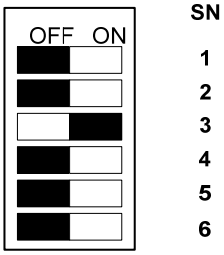
3) It is necessary to add (change position to ON): 2.0 s (SN:3)= 2.0 s

ST

4) The setting is equal to: minimum (MIN) value of setting range + added (ON) values = 7.5 s (MIN) + 2.0 s (SN:3) = 9.5s

The remaining switches should be in the OFF position: 0.5 s (SN:1), 1.0 s (SN:2), 4.0 s (SN:4), 8.0 s (SN:5), 16 s (SN:6) and Setting group (OFF)

5) The position of the tI> DIP switch should be as follows:



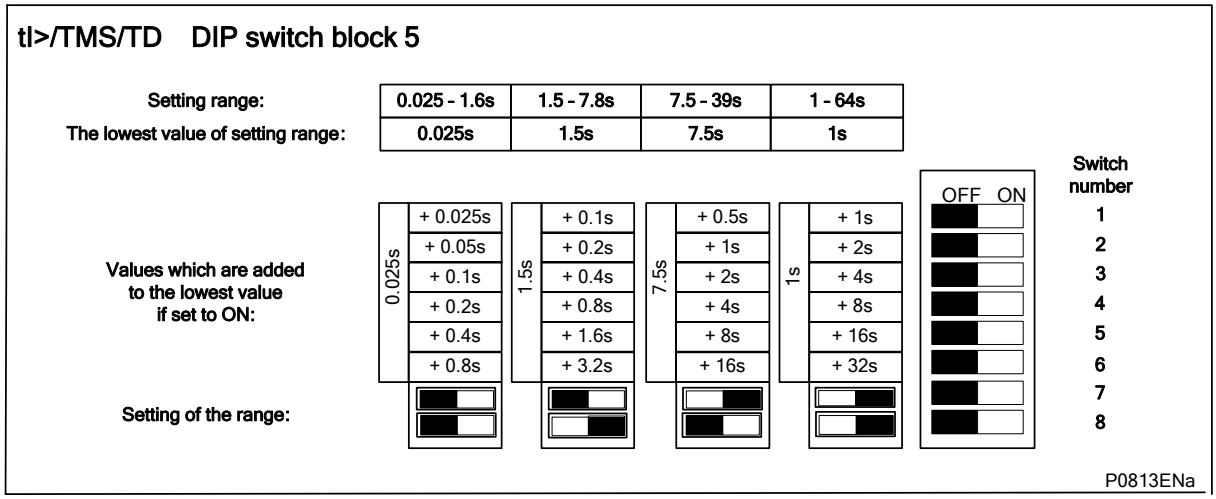


Table 5: Time delay setting for the first overcurrent stage (tI>)

1.2.1.2 Second overcurrent protection stage I>>

The second overcurrent stage (I>>) has a DT time-delay characteristic only. The setting of the second stage current threshold is shown in Table 6.

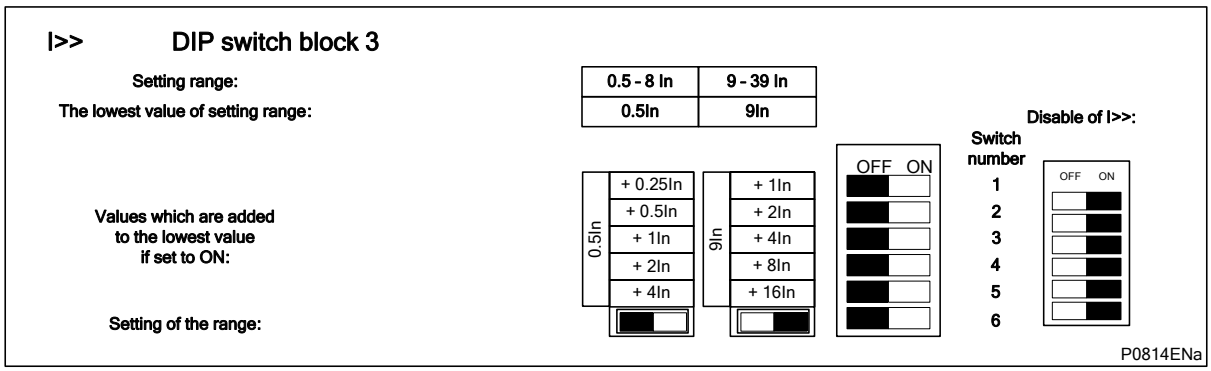


Table 6: Current threshold setting for the second overcurrent stage (I>>)

The time delay setting is shown in Table 7.

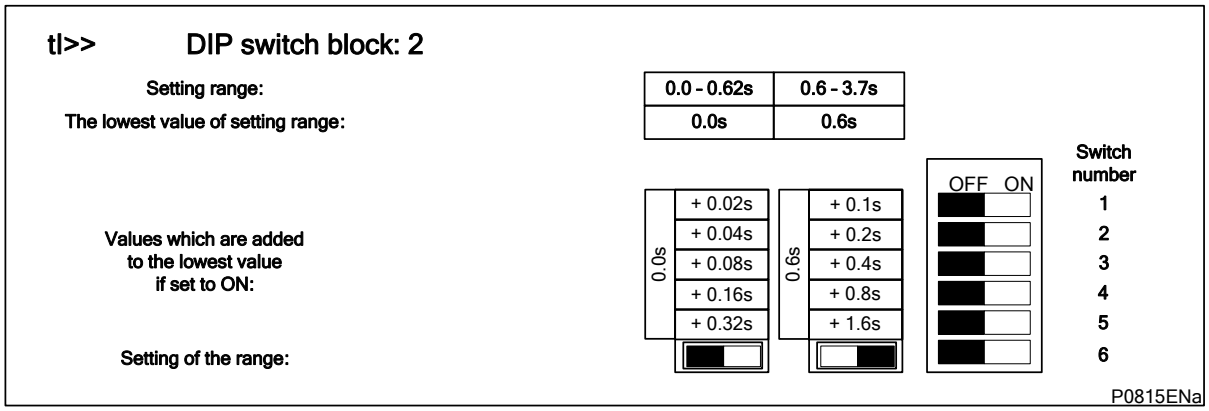


Table 7: Time delay setting for the second overcurrent stage (tI>>)

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1.2.2 Earth fault overcurrent protection

The earth fault overcurrent protection included in the P114D relay provides two stage (IN>, IN>>) non-directional overcurrent protection with independent time delay characteristics.

All settings refer to nominal current Ien (ordering option: 1 A or 5 A)

1.2.2.1 First e/f overcurrent protection stage IN>

The first overcurrent stage (IN>) has time-delayed characteristics which are selectable (DIP switch block 10: “CHAR.”) between:

- Group 1 (IEC & UK). DIP switch block 10 number 4 set to OFF:
    - DT: Definite time characteristic
    - SI: Standard Inverse Time Characteristic (IEC)
    - VI: Very Inverse Time Characteristic (IEC)
    - EI: Extremely Inverse Time Characteristic (IEC)
    - LTI: UK Long Time Inverse Characteristic
    - STI: Schneider Electric Short Time Inverse Characteristic
    - RC: UK Rectifier Characteristic
- Group 2 (IEEE & US) . DIP switch block 10 number 4 set to ON:
    - MI: Medium Inverse Time Characteristic (IEEE)
    - VI: Very Inverse Time Characteristic (IEEE)
    - EI: Extremely Inverse Time Characteristic (IEEE)
    - CO2: US Short Time Inverse Characteristic
    - CO8: US Inverse Characteristic
    - RI: Electromechanical Inverse Characteristic

Further details are given in the “Operation” chapter of this manual (P114D/EN OP)

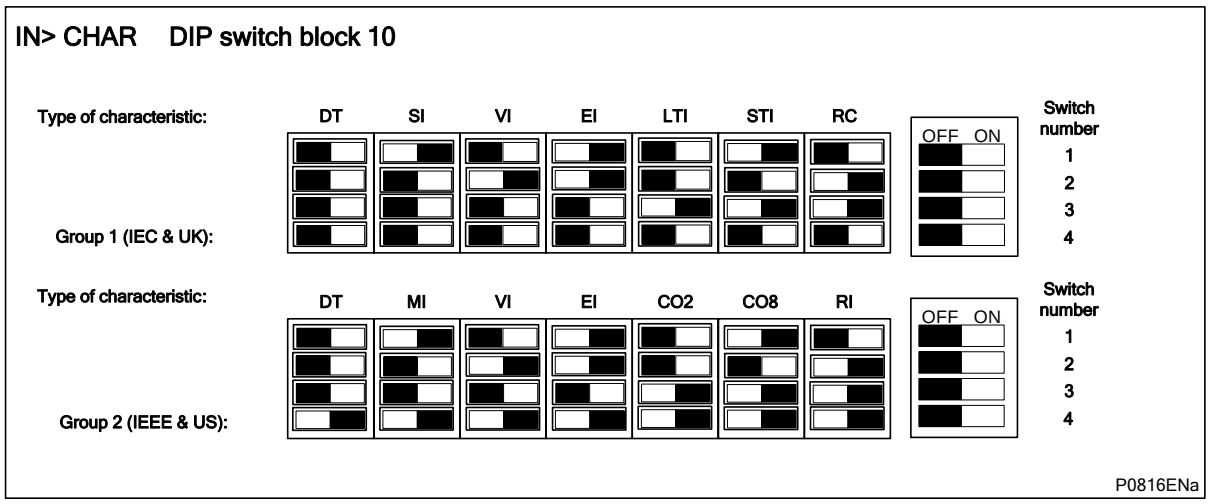

Table 8: Time characteristic setting for the first stage element IN>

ST

ANSI (MI, VI, EI) and IEC (SI, VI, EI) characteristics can be set with instantaneous reset (for current below the current threshold) or with an IDMT reset time delay. The setting of the reset mode is made via DIP switch block 6, switch number 0 (Table 4). If the switch number 0 is set to OFF, the reset of the time delay for currents below the overcurrent stage is instantaneous, if switch number 0 is set to ON, the reset of IN> time delay is has an IDMT characteristic (depends on the current below current threshold).

This setting is common to I> and IN> characteristics

Further details are given in the “Operation” chapter of this manual (P114D/EN OP).

The current threshold setting according to the ordering option:

- 0.01 – 2 Ien is shown in Table 9
- 0.05 – 10 Ien is shown in Table 10
- 0.2 – 40 Ien is shown in Table 11

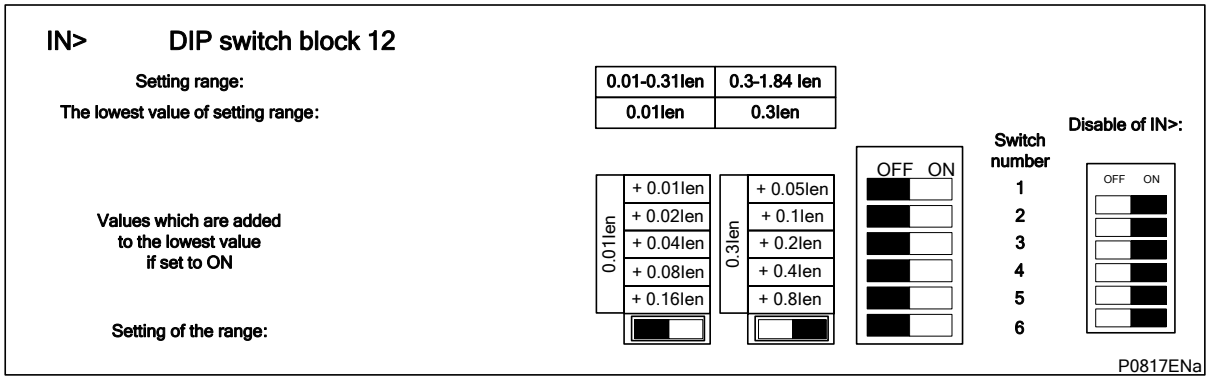

Table 9: Current threshold setting for earth fault protection (IN>). Ordering option: 0.01 – 2.00Ien.

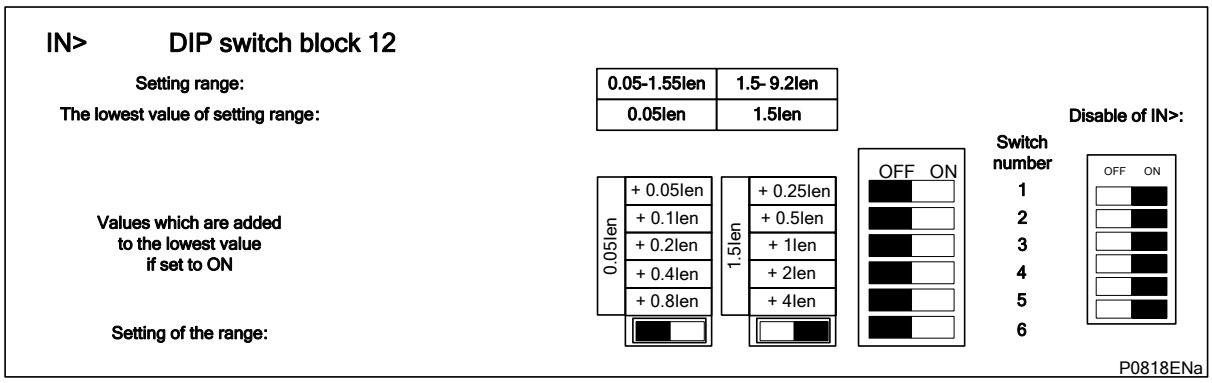

Table 10: Current threshold setting for earth fault protection (IN>). Ordering option: 0.05 – 10.00 Ien.

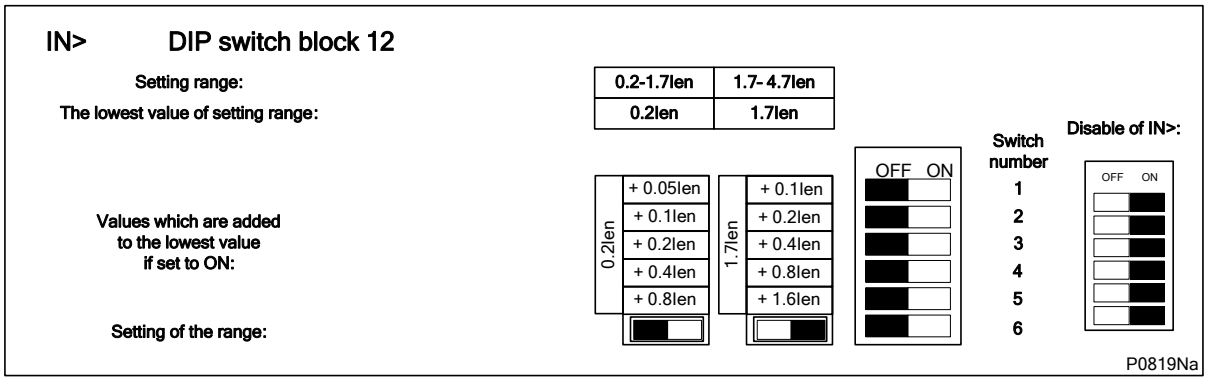

Table 11: Current threshold setting for earth fault protection (IN>). Ordering option: 0.2 – 40.00Ien.

The time delay setting is shown in Table 12.

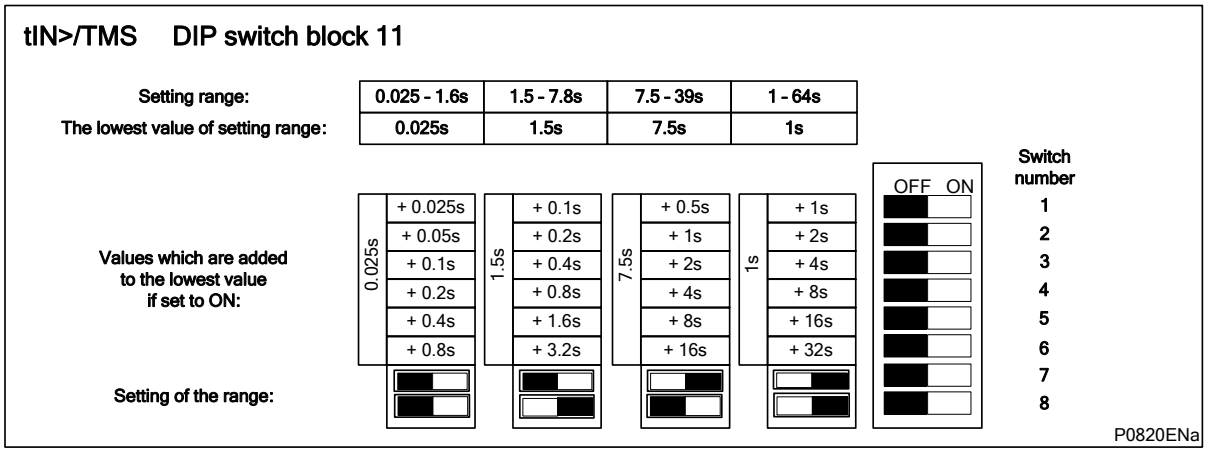

Table 12: Time delay setting for earth fault protection IN>

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1.2.2.2 Second e/f overcurrent protection stage IN>>

The second e/f overcurrent stage (IN>>) has a DT time-delay only.
The setting for the second stage current threshold according to the ordering option is as follows:

- 0.01 – 2 Ien is shown in Table 13
- 0.05 – 10 Ien is shown in Table 14
- 0.2 – 40 Ien is shown in Table 15

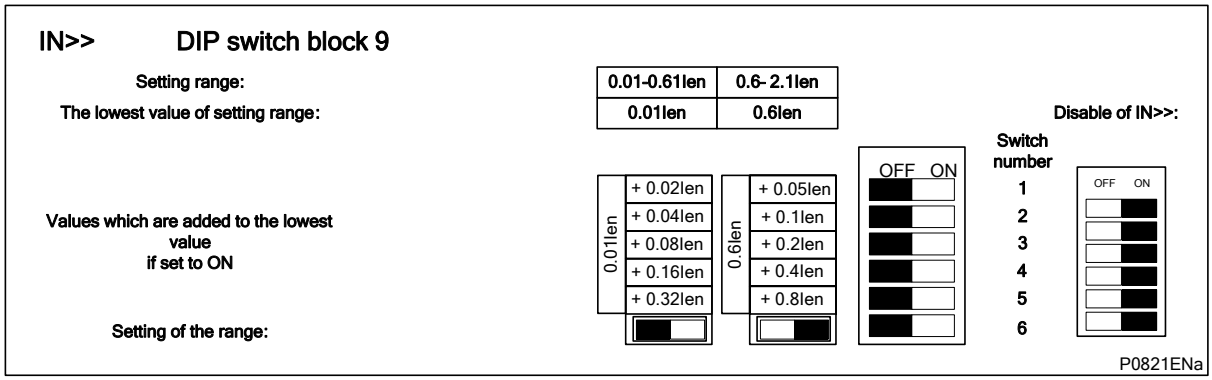

Table 13: Current threshold setting for earth fault protection (IN>>). Ordering option: 0.01 – 2.00Ien.

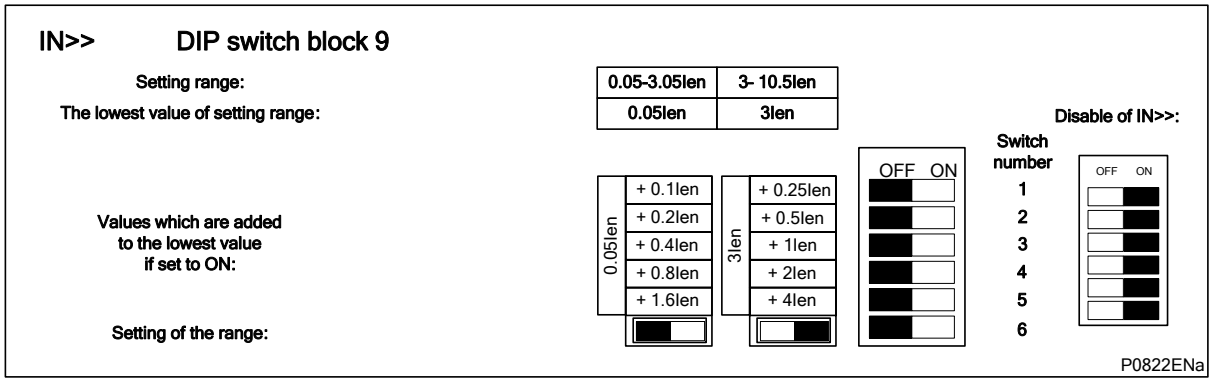

Table 14: Current threshold setting for earth fault protection (IN>>). Ordering option: 0.05 – 10.00 Ien.

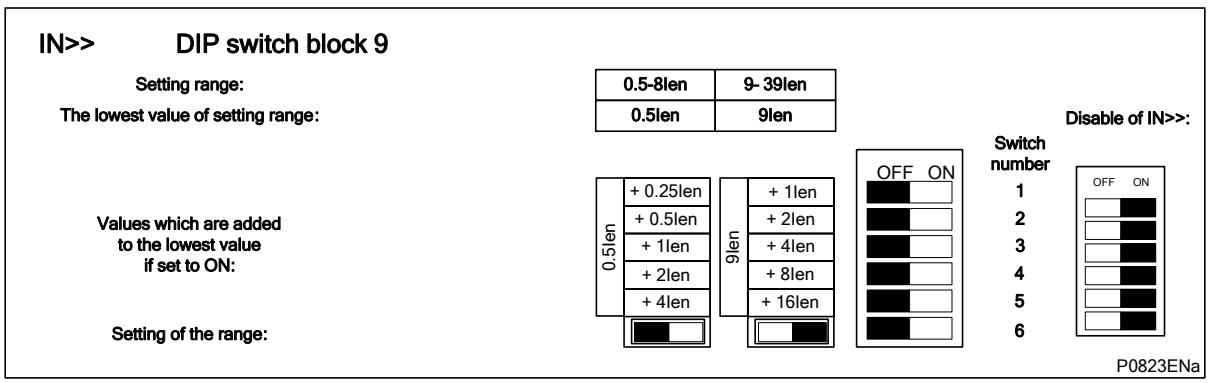

Table 15: Current threshold setting for earth fault protection (IN>>). Ordering option: 0.2 – 40.00 Ien.

The time delay setting is shown in Table 17.

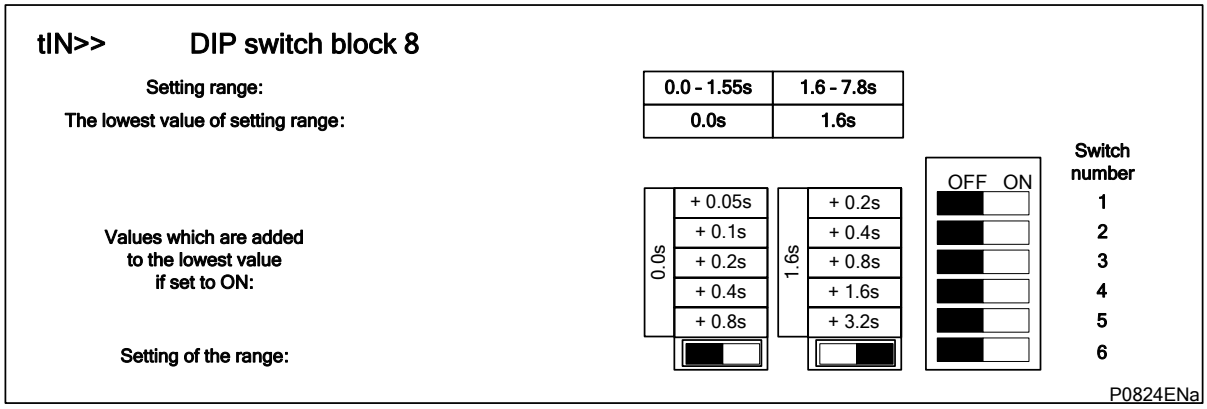

Table 16: Time delay setting for the second stage element IN>>

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1.2.3 Configuration

Protection settings are available via DIP switches only, but configuration of inputs or outputs can be made via DIP switches or setting software (USB port).

This information is clearly visible on the front panel. DIP Switch Block 1 Number 2 ("DIP I/O" / "USB I/O") (Table 19) configures which I/O configuration settings are taken into account: DIP switch configuration ("DIP I/O") or settings made by setting software ("USB I/O").

If Switch Number 2 ("**DIP I/O**" / "USB I/O") is **OFF** ("DIP I/O") it means that I/O configuration of the P114D is made via DIP Switch Block 7. (Table 18).

If Switch Number 1 ("DIP I/O" / "**USB I/O**") is **ON**. It means that settings on DIP Switch Block 7 are inactive so P114D is set via the MiCOM S1 setting software.

The factory USB settings are as follows: I/O DIP switch configuration: Switch Block 7 Number 1 OFF ("L1 - blocking of I>>") and Switch Number 2 OFF ("RL – Group 1").

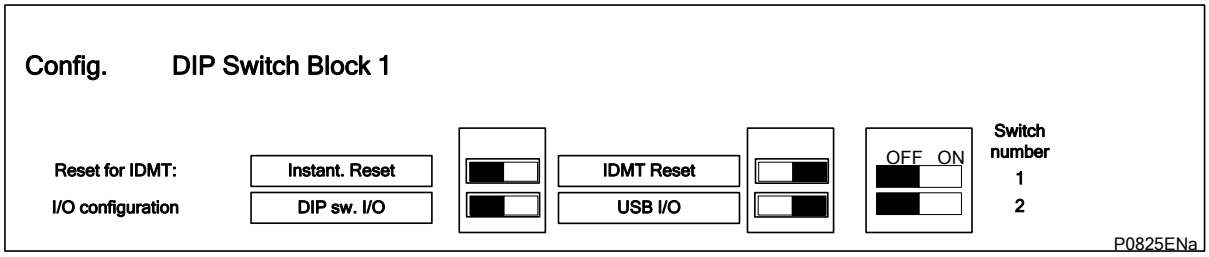

Table 17: How to set I/O configuration: DIP switches or setting software

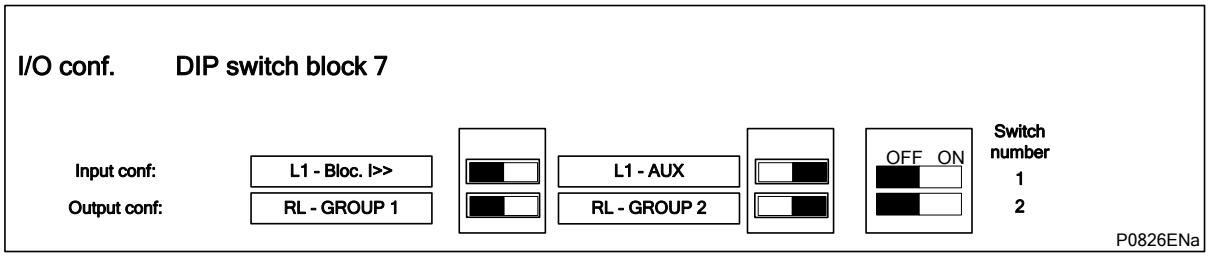

Table 18: I/O configuration via DIP switches

Input configuration

In the P114D's memory Binary Input configuration has three setting groups:

- "Input GROUP 1": DIP Switch Block 7 Number 1 ("**L1 - blocking of I>>**" / ("L1 – AUX") **OFF** ("L1 - blocking of I>>") and Switch Block 1 Number 2 ("**DIP I/O**" / "USB I/O") **OFF** ("DIP I/O"),
- "Input GROUP 2": DIP Switch Block 7 Number 1 OFF ("L1 – AUX") and Switch Block 1 Number 2 OFF ("DIP I/O"),
- "Input GROUP 3" (setting software settings made via USB port): DIP Switch Block 1 Number 2 ON ("USB I/O") and Switch Block 7 Number 1 ("**L1 - blocking of I>>**" / ("**L1 – AUX**") **OFF** or **ON** (any position)

"Input GROUP 1" ("L1 – AUX") is set as follows:

- input L1 is configured for blocking of I>> protection stage
- input L2 is configured for reset of latched LEDs and outputs

"Input GROUP 2" ("L1 - AUX") is set as follows:

- input L1 is configured to AUX function (trip via binary input)
- input L2 is configured for reset of latched LEDs and outputs

"Input GROUP 3" is configured via setting software using USB port. The following configuration is possible:

- Input 1: Block outputs, Reset latched outputs, Reset latched LEDs, Blocking scheme I>, Blocking scheme I>>, Blocking scheme IN>, Blocking scheme IN>>, 52A, 52B, AUX, CB not ready
- Input 2: Block outputs, Reset latched outputs, Reset latched LEDs, Blocking scheme I>, Blocking scheme I>>, Blocking scheme IN>, Blocking scheme IN>>, 52A, 52B, AUX, CB not ready

Every input can be configured to one or more available functions (matrix). For example L1 to: Blocking scheme I> and Blocking scheme I>> function.

Factory (default) configuration of "Input GROUP 3" is:

- Input 1: Blocking scheme I>>
- Input 2: Reset latched outputs and Reset latched LEDs

Meaning of above functions:

- Blocking outputs: if the input is energized (in high state) all outputs are re-energized (in the same state as without powering of P114D hardware). This function can be used for testing relays without tripping the CB and signaling to substation (test mode)
- Reset latched output: if the outputs are latched and this input is energized (in high state) all latched outputs are reset
- Reset latched LEDs: if LEDs are lit after trip, energizing of input (high state) turns LEDs off (if there is no current trip reason)
- Blocking scheme: energizing of input resets the protection time delay
- 52A: status of CB for information (RS485, events) only
- 52B: status of CB for information (RS485, events) only
- AUX: auxiliary function. energizing of input lights up the AUX LED with latching. This function can be mapped to the outputs. It can be used for tripping via a binary input.
- CB not ready: blocking of remote (RS485) close command if the input is energized.

Output configuration

Binary Output configuration has three setting groups:

- "Output GROUP 1": DIP Switch Block 7 Number 2 ("**RL – GROUP 1**" / "RL – GROUP 2") **OFF** and Switch Block 1 Number 2 ("**DIP I/O**" / "USB I/O") **OFF** ("DIP I/O"),
- "Output GROUP 2": DIP Switch Block 7 Number 2 ON ("RL – GROUP 2") and Switch Block 1 Number 2 OFF ("DIP I/O"),
- "Output GROUP 3" (setting software settings made via USB port): DIP Switch Block 1 Number 2 ON ("USB I/O") and Switch Block 7 Number 2 ("**RL – GROUP 1**" / "**RL – GROUP 2**") **OFF** or **ON** ,

"Output GROUP 1" is set as follows:

- output RL1 is configured to Any Trip (tI>, tI>>, tIN>, tIN>, AUX) with a 0.4 s pulse, without latching the output
- output RL2 is configured to Any trip (tI>, tI>>, tIN>, tIN>, AUX), without latching the output
- output RL3 (optional) is configured to Any trip (tI>, tI>>, tIN>, tIN>, AUX), with latching via fixed time (factory setting: 3 days). Latching can be reset at any time via a Binary Input mapped to the "Reset latched outputs" function
- output RL4 (optional) is mapped to the start of the I>> stage

Note: Relay 3 in the above setting group can be used in special applications to disconnect the auxiliary voltage (Vx) from the substation's battery after a fixed time (factory setting: 3 days). This application is recommended for small MV substations with low capacity batteries. RL3 is connected between auxiliary voltage VX terminals and the battery. In normal conditions RL3 is open and P114D is not supplied from the battery. After a trip signal, RL3 is closed, to supply the P114D from the substation's battery (via an auxiliary voltage input) to allow signalling on the relay and communication facilities. After the set time delay, a reset command via RS485 or a binary input reset, RL3 opens to disconnect the P114D from the substation's battery auxiliary voltage.

Further details are given in the "Application" chapter of this manual (P114D/EN AP)

"Output GROUP 2" is set as follows::

- output RL1 is configured to tI>, tI>>, AUX, without latching the output
- output RL2 is configured to tIN>, tIN>), without latching the output
- output RL3 (optional) is configured to tI>, tI>>, AUX, without latching the output
- output RL4 (optional) is configured to tIN>, tIN>), without latching the output

"Output GROUP 3" is configured via setting software using USB port. The following configuration is possible (matrix):

- output RL1: Any trip (pulse 0.4s), Any trip, start I>, start I>>, start IN>, start IN>>, tI>, tI>>, tIN>, tIN>>, AUX, Close of CB, watchdog
- output RL2: Any trip, Any trip (pulse 0.4s), Any trip, start I>, start I>>, start IN>, start IN>>, tI>, tI>>, tIN>, tIN>>, AUX, Any trip with latching via fixed time (factory setting: 3 days), Close of CB, watchdog
- output RL3 (optional): Any trip, Any trip (pulse 0.4s), Any trip, start I>, start I>>, start IN>, start IN>>, tI>, tI>>, tIN>, tIN>>, AUX, , Any trip with latching via fixed time (factory setting: 3 days),), Close of CB, watchdog
- output RL4 (optional): Any trip, Any trip (pulse 0.4s), Any trip, start I>, start I>>, start IN>, start IN>>, tI>, tI>>, tIN>, tIN>>, AUX, , Any trip with latching via fixed time (factory setting: 3 days), Close of CB, watchdog

Every output (RL1, RL2, RL3, RL4) can be set with or without latching.

General configuration

Via the USB port it is possible to change some parameters such as:

- Phase CT ratio (0-9999, step: 1), used for measuring, available via RS485 only.
- E/F CT ratio (0-9999, step: 1), used for measuring, available via RS485 only.
- Trip pulse (tT) used by “Any trip with latching via fixed time” logic. (0-6500 min, step: 1 min). Factory setting is 3 days (4320 min)
- Close pulse (tC) used for Close command via RS485 function (0.1-2 s, step: 0.1 s). Factory setting: 0.4 s.
- Trip pulse (tP) used by “Any trip with pulse” and for Trip command via RS485 function. (1-9999mn, step 1mn). Factory setting: 4320mn (3 days).
- Baud Rate for RS485 (2400b/s, 4800b/s, 9600b/s, 19200b/s, 38400b/s). Factory setting 19200b/s
- Address for RS485 (1-2560, step: 1). Factory setting: 1.
- Parity for RS485 (None, Odd, Even). Factory setting: None.
- Stop bits for RS485 (1 or 2 bits). Factory setting: 1 bit.

OP

OPERATION

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

OP

CONTENTS

OP

1. OPERATION OF INDIVIDUAL PROTECTION FUNCTIONS

The P114D is supplied from power system CTs. The operation of the P114D requires a minimum current flowing in one of the three phases. The minimum current required for operation is 20% of the nominal current of the relay. The energy taken from the current is used to charge up the integrated capacitors: trip outputs and relay outputs (trip indicator). If any protection trips, the energy is provided to terminals 29-30 (CB coil output) and 27-28 (flag indicator output). The output signal is a pulse, the repetition of this is dependent on the trip coil's impedance and on the current level.

The following sections detail the individual protection functions.

1.1 Overcurrent protection

The overcurrent protection included in the P114D relays provides two-stage non-directional three-phase overcurrent protection with independent time delay characteristics. All overcurrent settings apply to all three phases but are independent for each of the two stages.

The first stage of overcurrent protection has time-delayed characteristics which are selectable between inverse definite minimum time (IDMT), or definite time (DT). The second stage has a definite time characteristic only.

Various methods are available to achieve correct relay co-ordination on a system; by means of time alone, current alone or a combination of both time and current. Grading by means of current is only possible where there is an appreciable difference in fault level between the two relay locations. Grading by time is used by some utilities but can often lead to excessive fault clearance times at or near source substations where the fault level is highest. For these reasons the most commonly applied characteristic in coordinating overcurrent relays is the IDMT type.

The inverse time delayed characteristics indicated above comply with the following formulae:

IEC curves: $t = TMS \cdot \frac{\beta}{M^{\alpha} - 1}$;

IEEE/ANSI curves: $t = TD \cdot \frac{\beta}{M^{\alpha} - 1} + L$;

where:

t = Operating time in [s]

β = Constant

$M = \frac{I}{Is}$

I = Measured current in [A]

TMS = Time setting [s]

Is = Current threshold setting [A]

α = Constant

L = ANSI/IEEE Constant

Type of Curve	Standard	β	α	L
Standard Inverse Time (SI)	IEC	0.14	0.02	0
Very Inverse Time (VI)	IEC	13.5	1	0
Extremely Inverse Time (EI)	IEC	80	2	0
Long Time Inverse (LTI)	UK	120	1	0
Short Time Inverse (STI)	UK	0.05	0.04	0
Rectifier (Rect)	UK	45900	5.6	0
Moderately Inverse Time (MI)	IEEE	0.0515	0.02	0.114
Very Inverse Time (VI)	IEEE	19.61	2	0.491
Extremely Inverse Time (EI)	IEEE	28.2	2	0.1217
Time Inverse (CO8)	US	5.95	2	0.18
Short Time Inverse (CO2)	US	0.16758	0.02	0.11858

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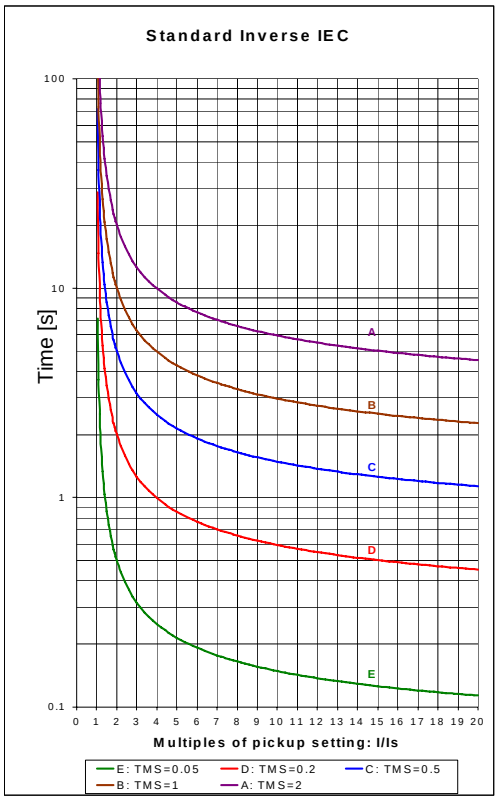
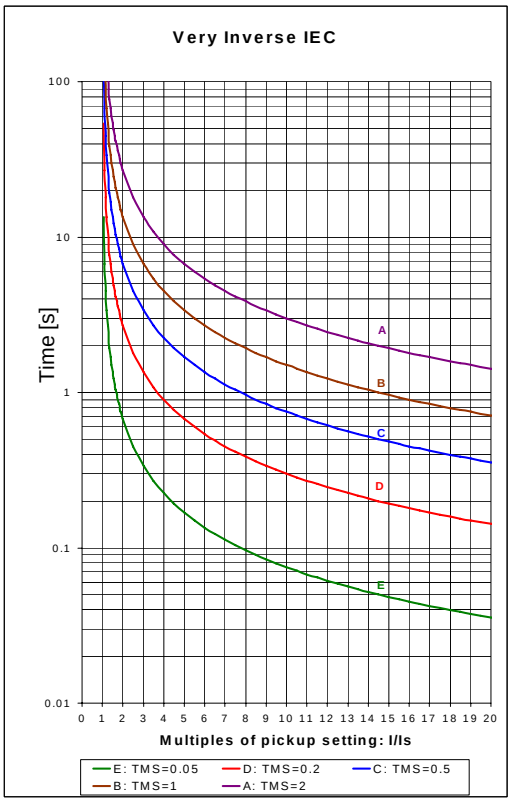
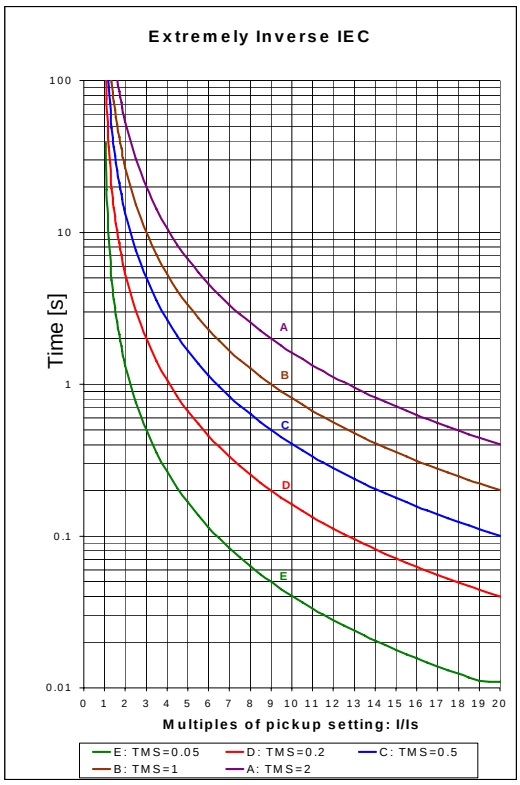
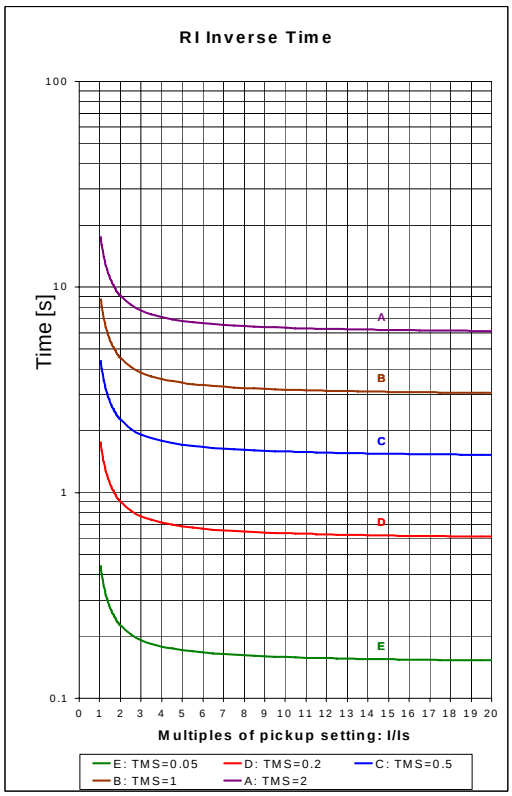
A time multiplier setting TMS is used to adjust the operating time of IEC & UK IDMT curves.

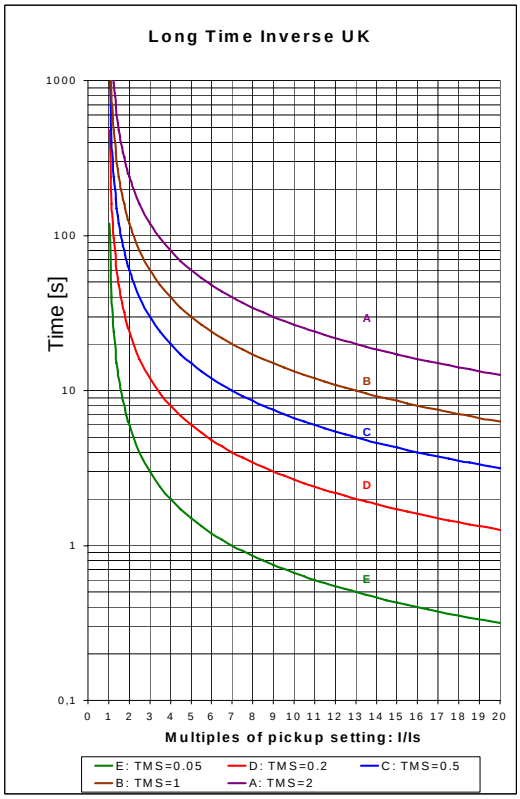
A time multiplier setting TD is used to adjust the operating time of IEEE/ANSI or US IDMT curves.

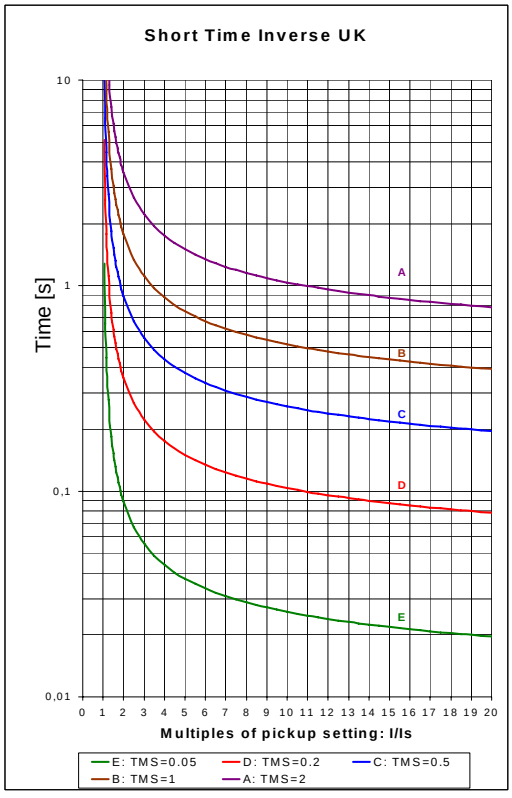





Extremely Inverse IEC
Time [s]
100
10
1
0.1
0.01
A
B
C
D
E
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2

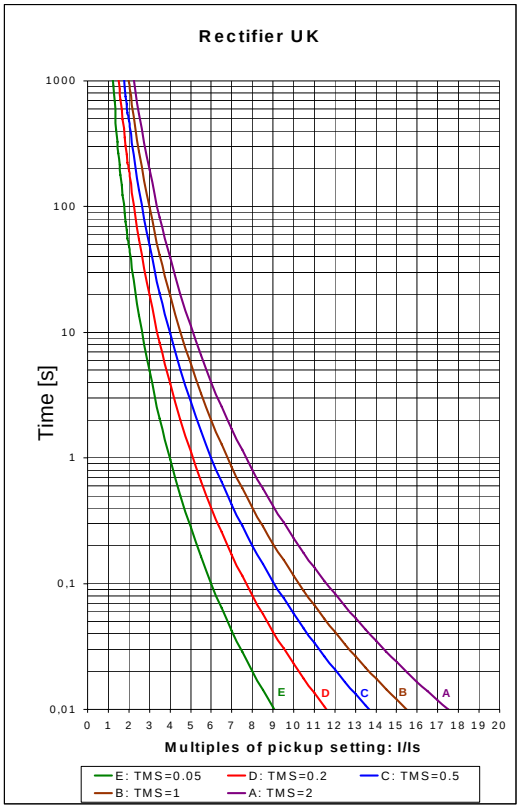

RI Inverse Time
Time [s]
100
10
1
0.1
A
B
C
D
E
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2

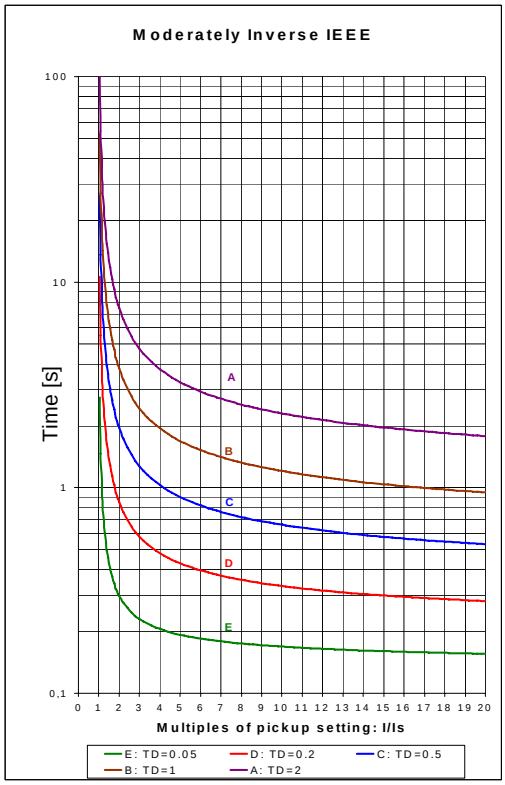

Long Time Inverse UK
Time [s]
1000
100
10
1
0,1
A
B
C
D
E
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2

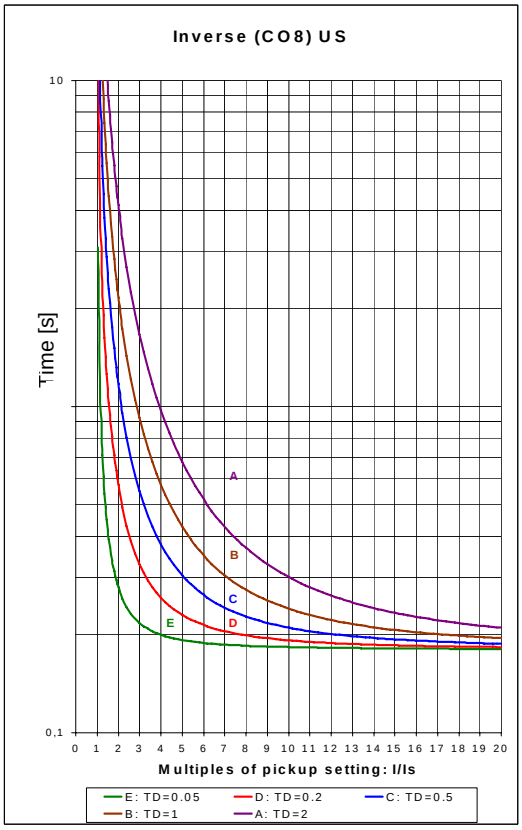

Short Time Inverse UK
Time [s]
10
1
0,1
0,01
A
B
C
D
E
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2

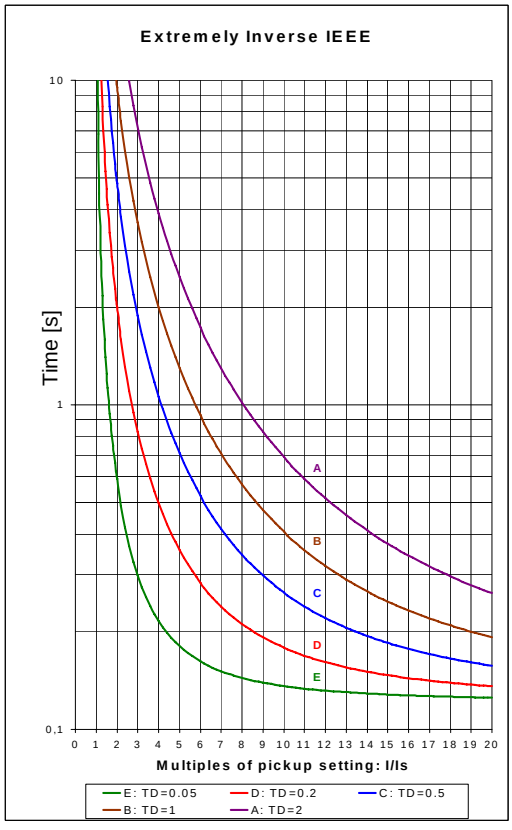
OP

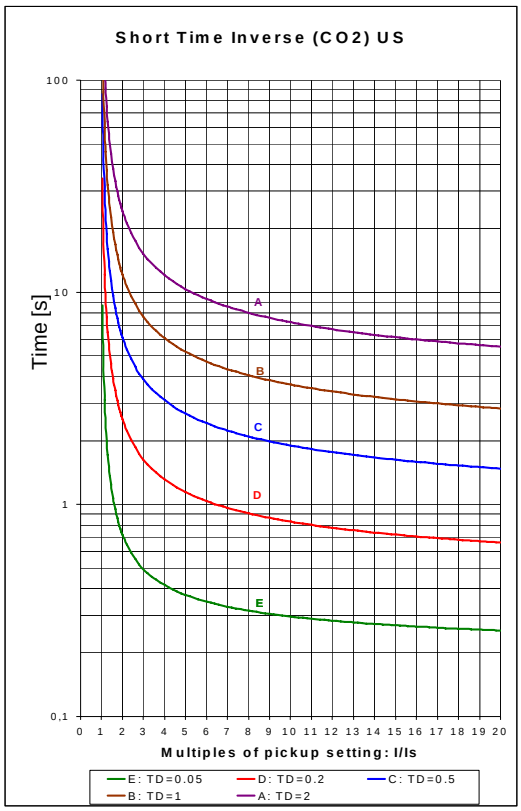
OP

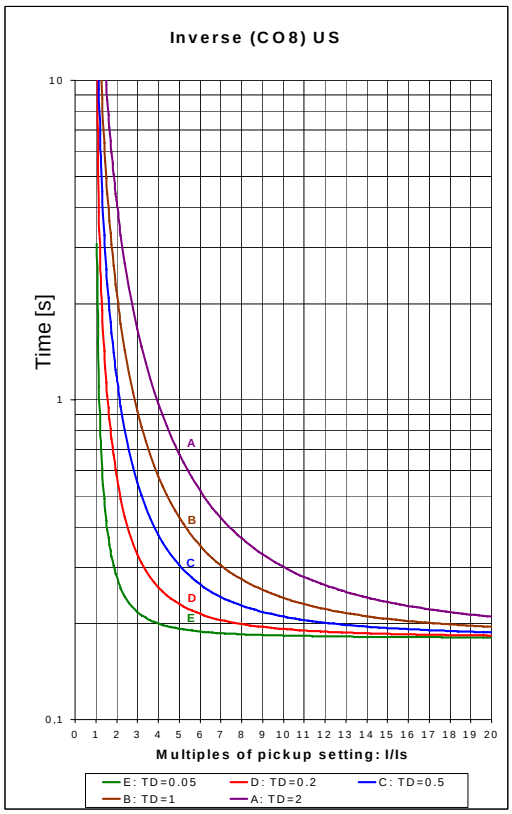

Rectifier UK
Time [s]
1000
100
10
1
0,1
0,01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
E
D
C
B
A
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2


Moderately Inverse IEEE
Time [s]
100
10
1
0,1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2


Inverse (CO8) US
Time [s]
10
1
0,1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2


Extremely Inverse IEEE
Time [s]
10
1
0,1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2





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Reset Characteristic

IEEE/US/IEC

The IEEE/US/IEC curves may have an inverse time reset characteristic or instantaneous reset. The following equation can be used to calculate the inverse reset time for IEEE/US/IEC curves:

IEC:

$$reset\ time = TMS \cdot \frac{tr}{1 - M^2}$$

IEEE and US:

$$reset\ time = TD \cdot \frac{tr}{1 - M^2}$$

where:

TD = Time dial setting for IEEE/US curves

TMS = A time multiplier setting for IEC curves

S = Constant

M = I/Is

Type of Curve	Standard	tr
Standard Inverse Time (SI)	IEC	12.1
Very Inverse Time (VI)	IEC	43.2
Extremely Inverse Time (EI)	IEC	80
Long Time Inverse (LTI)	UK	0
Short Time Inverse (STI)	UK	0
Rectifier (Rect)	UK	0
Moderately Inverse Time (MI)	IEEE	4.9
Very Inverse Time (VI)	IEEE	21.6
Extremely Inverse Time (EI)	IEEE	29.1
Time Inverse (CO8)	US	5.95
Short Time Inverse (CO2)	US	2.261

Note: The reset time setting is common for I> and IN>.

RI curve

The RI curve (electromechanical) has been included in the first stage characteristic setting options for phase overcurrent and earth fault protections. The curve is represented by the following equation.

RI-Inverse Time: $t = TMS \cdot \frac{1}{0.339 - \frac{0.236}{M}}$;

1.2 Earth fault protection

The Earth fault element operates from a measured earth fault current quantity.

The first stage of overcurrent protection has time-delayed characteristics which are selectable between inverse definite minimum time (IDMT), or definite time (DT). The second stage has a definite time characteristic only.

The type of characteristics are the same as for phase protection elements:

- IEC SI: Standard Inverse Time
- IEC VI: Very Inverse Time
- IEC EI: Extremely Inverse Time
- UK LI: Long Time Inverse
- UK STI: Short Time Inverse
- UK Rect: Rectifier
- RI: Electromechanical Inverse
- IEEE MI: Moderately Inverse Time
- IEEE VI: Very Inverse Time
- IEEE EI: Extremely Inverse Time
- US CO2: Short Time Inverse
- US CO8: Time Inverse

The mathematical formulae and curves for the twelve Inverse Time characteristics available with the P114D are presented in section 1.1 of this chapter.

The IEEE/US/IEC curves may have an inverse time reset characteristic or instantaneous reset. This setting is common for phase and earth fault protection element.

Depending on the connection of e/f CT to current terminals, e/f current can supply the P114D (terminals 7 and 9) or not supply the P114D (terminals 8 and 9).

1.3 External trip via opto-input

For some applications it is necessary to issue a CB trip via a binary input. An input configured to “L1 - AUX” can be used to that effect.

Tripping is instantaneous.

An auxiliary voltage connected to such an input will energize any output relays configured for Any Trip or AUX function.

The Low Energy Trip Coil is activated if RL1 is configured to Any Trip or AUX function.

1.4 Blocked overcurrent scheme logic

The second stage of phase protection element I>> can be blocked via an adequately configured binary input for Blocking scheme I>>” function (“L1 - blocking of I>>”).

1.5 Reset of latched LEDs and outputs

Resetting of latched LEDs and outputs depends on the input configuration reset for latched LEDs. Output resets can be made via external inputs or via the communication port.

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APPLICATION NOTES

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

AP

CONTENTS

FIGURES

1. INTRODUCTION

1.1 Protection of feeders

The secure and reliable distribution of power within a network is heavily dependent upon the integrity of the underground cables which link the various sections of the network together. The associated protection system must also provide both secure and reliable operation.

The most common fault conditions, on both MV transformers and cables, are short circuit faults. Such faults may occur between phases but will most often involve one or more phases becoming short circuit to earth. Faults of this nature require the fastest possible fault clearance times but at the same time allowing suitable co-ordination with other downstream protection devices.

The effect of fault resistance is more pronounced on lower voltage systems, resulting in potentially lower fault currents, which in turn increases the difficulty in the detection of high resistance faults. In addition, many distribution systems use earthing arrangements designed to limit the passage of earth fault current. Methods such as resistance earthing, Petersen Coil earthing or insulated systems make the detection of earth faults difficult. Special protection requirements are often used to overcome these problems.

The CT-powered P114D is used in MV switchboards with circuit breakers to protect distribution transformers, feeders and lines in local and industrial power systems. The small compact case allows this relay to be used in these situations.

Due to the dual powered function, P114D can be used as backup protection of HV/MV transformers

Before carrying out any work on the equipment, the user should be familiar with the contents of the Safety Guide SFTY/4L M/E11 or later issue, OR the safety and technical data section of the technical manual and also the ratings on the equipment rating label.

For safety reasons, no work must be carried out on the P114D until all power sources to the unit have been disconnected.

2. APPLICATION OF INDIVIDUAL PROTECTION FUNCTIONS

The following sections detail individual protection functions in addition to where and how they may be applied. Each section provides some worked examples on how the settings are applied to the relay.

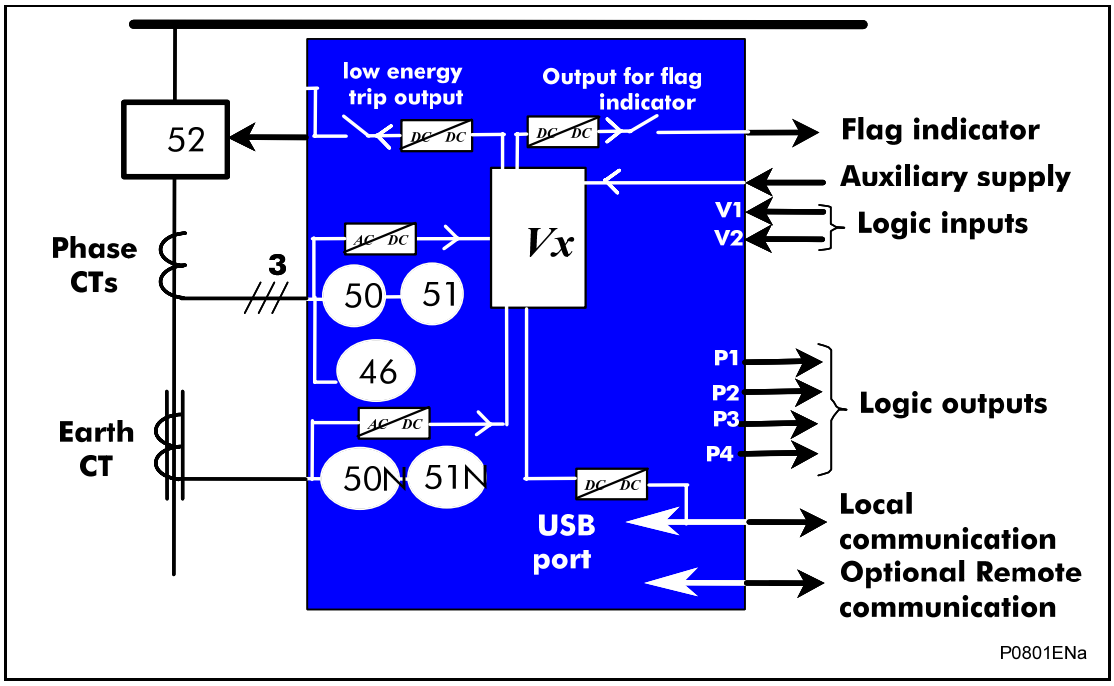

Figure 1: P114D single-line functional diagram (all options are included)

2.1 Overcurrent protection

Overcurrent relays are the most commonly used protective devices in any industrial or distribution power system. They provide main protection to both feeders and busbars when unit protection is not used. They are also commonly applied to provide back-up protection when unit systems, such as pilot wire schemes, are used.

There are a few application considerations when applying overcurrent relays.

2.1.1 Transformer magnetizing inrush

When applying overcurrent protection to the MV side of a power transformer it is usual to apply a high set instantaneous overcurrent element in addition to the time delayed low-set, to reduce fault clearance times for MV fault conditions. Typically, this will be set to approximately 1.3 times the LV fault level, so that it will only operate for MV faults. A 30% safety margin is sufficient due to the low transient overreach. Transient overreach defines the response of a relay to DC components of fault current and is quoted as a percentage.

The second requirement for this element is that it should remain inoperative during transformer energization, when a large primary current flows for a short period during switch on. In most applications, the requirement to set the relay above the LV fault level will automatically result in settings that will be above the level of magnetizing inrush current.

Both overcurrent stages operate on True RMS component. Hence, for the second overcurrent stage in P114D relays, it is possible to apply settings corresponding to 35% of the peak inrush current, whilst maintaining stability for the condition.

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2.1.2 Application of timer hold facility for IEC/IEEE/US IDMT characteristics

This feature may be useful in certain applications, for example when grading with upstream electromechanical overcurrent relays, which have inherent reset time delays. Setting of the hold timer to a value other than zero, delays the resetting of the protection element timers for this period thus allowing the element to behave similarly to an electromechanical relay.

Another possible situation where the timer hold facility may be used to reduce fault clearance times is where intermittent faults may be experienced. An example of this may occur in a plastic insulated cable. In this application it is possible that the fault energy melts and reseals the cable insulation, thereby extinguishing the fault. This process repeats to give a succession of fault current pulses, each of increasing duration with reducing intervals between the pulses, until the fault becomes permanent.

When the reset time of the overcurrent relay is instantaneous, the relay will be repeatedly reset and not be able to trip until the fault becomes permanent. By using the Timer Hold facility for IDMT characteristics the relay will integrate the fault current pulses, thereby reducing fault clearance time.

The mathematical formulae and curves for the IDMT Hold Timer characteristics available with the P114D are presented in chapter OP (“Operation”).

Note 1: The reset time setting is common to I> and IN>.

Note 2: LTI, STI, Rect, RI characteristics have instantaneous reset even if the setting is with IDMT Reset (tr = 0)

2.1.3 Setting guidelines

When applying the overcurrent protection provided in the P114D relays, standard principles should be applied in calculating the necessary current and time settings for co-ordination The Network Protection and Automation Guide (NPAG) textbook offers further assistance. The example detailed below shows a typical setting calculation and describes how the settings are applied to the relay.

Assume the following parameters for a relay feeding an LV switchboard:

CT Ratio = 500 A/1 A

Full load current of circuit = 440 A

Slowest downstream protection = 100 A Fuse

The current setting employed on the P114D relay must account for both the maximum load current and the reset ratio of the relay itself:

I> must be greater than: (440 A/0.95)/500 A = 0.9263 In

I> must be greater than: 0.9263 In

For setting range 0.2-1.7 In step is 0.05 In, so the closest I> set value = 0.95 In:

It means that DIP Switch Block 6 (I>) should be set as follows:

Number

1: ON (+0.05 In),

2: ON (+0.1 In),

3: ON (+0.2 In),

4: ON (+0.4 In),

5: OFF

6: OFF (setting range: 0.2 In to 1.7 In)

0.2 In (the lowest value for setting range: 0.2 In to 1.7 In, Switch Number 6: OFF) + 0.05 In (Switch Number 1: ON) + 0.1 In (Switch Number 2: ON) + 0.2 In (Switch Number 3: ON) + 0.4 In (Switch Number 4: ON) = 0.95 In

A suitable time delayed characteristic can now be chosen. When coordinating with downstream fuses, the applied relay characteristic should be closely matched to the fuse characteristic. Therefore, assuming IDMT co-ordination is to be used, an IEC Extremely Inverse (EI) time characteristic would normally be chosen. As previously described, this is found under "I> CHAR" DIP Switches Block 4 and should therefore be programmed as chosen above.

DIP Switch Block 4 (I> CHAR):

Number

1: ON

2: ON

3: OFF

4: OFF (IEC group)

Finally, a suitable time multiplier setting (TMS) must be calculated and entered in “tI>” DIP switches (TMS line).

MV/LV transformer application

Example:

Transformer:

Snom = 1000 kVA

Unom = 6 kV

CT ratio : 100 A/1 A

$$I_{nom} = \frac{S_{nom}}{\sqrt{3} \cdot U_{nom}} = \frac{1000kVA}{\sqrt{3} \cdot 6kV} = 96A$$

Where:

I_{nom} - nominal current of the transformer

S_{nom} - nominal power of the transformer

U_{nom} - nominal phase-phase voltage

Short circuit I>>

Primary setting value: 1.5 kA

I>> current stage on DIP switches:

$$I_{>>} = 1500A / 100A = 15[In]$$

$I_{>>}\_set\_value$: 15 In

Where:

$I_{>>}\_set\_value$: setting value of the short-circuit overcurrent stage on the “I>>” DIP Switch Block 3

Switch Block 3 (I>>) should be set as follows:

Number

1: OFF,

2: ON (+2 In),

3: ON (+4 In),

4: OFF,

5: OFF

6: ON (setting range: 9In to 39In)

The set value equals: 9 In (the lowest value for setting range: 9 In to 39 In, Switch Number 6 ON) + 2 In (Switch Number 2 ON) + 4 In (Switch Number 3 ON) = 15 In

Refer to *Table 8: Current setting for the second stage element* in chapter *P114D/EN ST* of this manual.

Overcurrent I>

Overcurrent stage tI> should be set above the normal load current.

If the primary setting value of I> equals 172 A, the set value on DIP switches is calculated as follows:

$$I_{>} = 172A/100A = 1.72 \cdot In$$

The closest greater value than 1.72 In is 1.8 In

So $I_{>}\_set\_value$: 1.8In

Where:

$I_{>}\_set\_value$: setting value of overcurrent stage “I>” on the DIP Switch Block 6

$I_{>}\_set\_value = 1.8$ In

Switch Block 6 (I>) should be set as follows:

Number

1: ON (+1 In),

2: OFF,

3: OFF,

4: OFF,

5: OFF

6: ON (setting range: 1.7 In to 4.7 In)

The set value equals: 1.7 In (the lowest value for setting range: 1.7 In to 4.7 In, Switch Number 6 ON) + 1 In (Switch Number 1 ON) = 1.8 In

Refer to *Table 6: Current stage setting for the first overcurrent protection* in chapter *P114D/EN ST* of this manual)

2.1.4 DT threshold

The first stage of the overcurrent characteristic for phase current (tI>) and e/f current (IN>) can be configured with a definite time (DT) delay or an IDMT characteristic.

The second O/C stage (I>>) and e/f (IN>>) stage are DT only.

2.1.5 IDMT threshold

The first phase (I>) and e/f (IN>) overcurrent threshold can be selected with an independent definite maximum time (IDMT) characteristic.

The time delay in relay operation is calculated with a mathematical formula which depends on the relay's current and TMS (IEC and UK) or TD (IEEE/ANSI and US) values.

There are twelve inverse time characteristics available:

- SI: Standard Inverse Time Characteristic (IEC)
- VI: Very Inverse Time Characteristic (IEC)
- EI: Extremely Inverse Time Characteristic (IEC)
- LTI: Long Time Inverse Characteristic (UK)
- STI: Short Time Inverse Characteristic (Schneider Electric)
- RC: Rectifier Characteristic (UK)
- MI: Medium Inverse Time Characteristic (IEEE/ANSI)
- VI: Very Inverse Time Characteristic (IEEE/ANSI)
- EI: Extremely Inverse Time Characteristic (IEEE/ANSI)
- CO2: Short Time Inverse Characteristic (US)
- CO8: Inverse Characteristic (US)
- RI: Electromechanical Inverse Characteristic

The mathematical formulae and curves for the twelve Inverse Time characteristics available with the P114D are presented in chapter OP (“Operation”).

2.2 Protection for silicon rectifiers

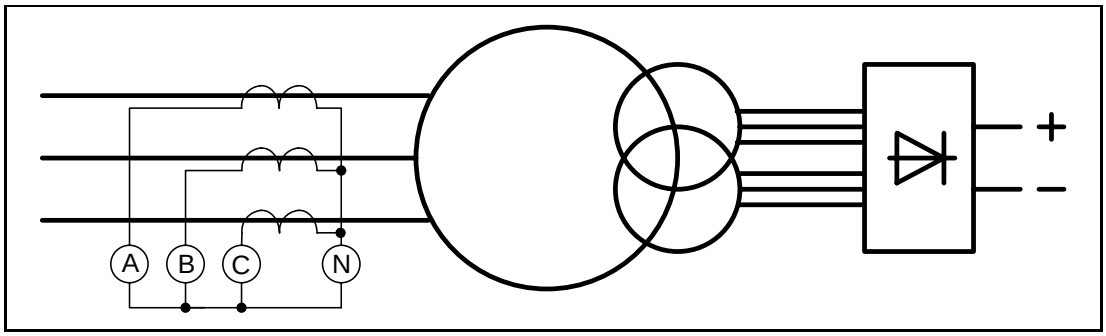

Figure 2: Protection for silicon rectifiers

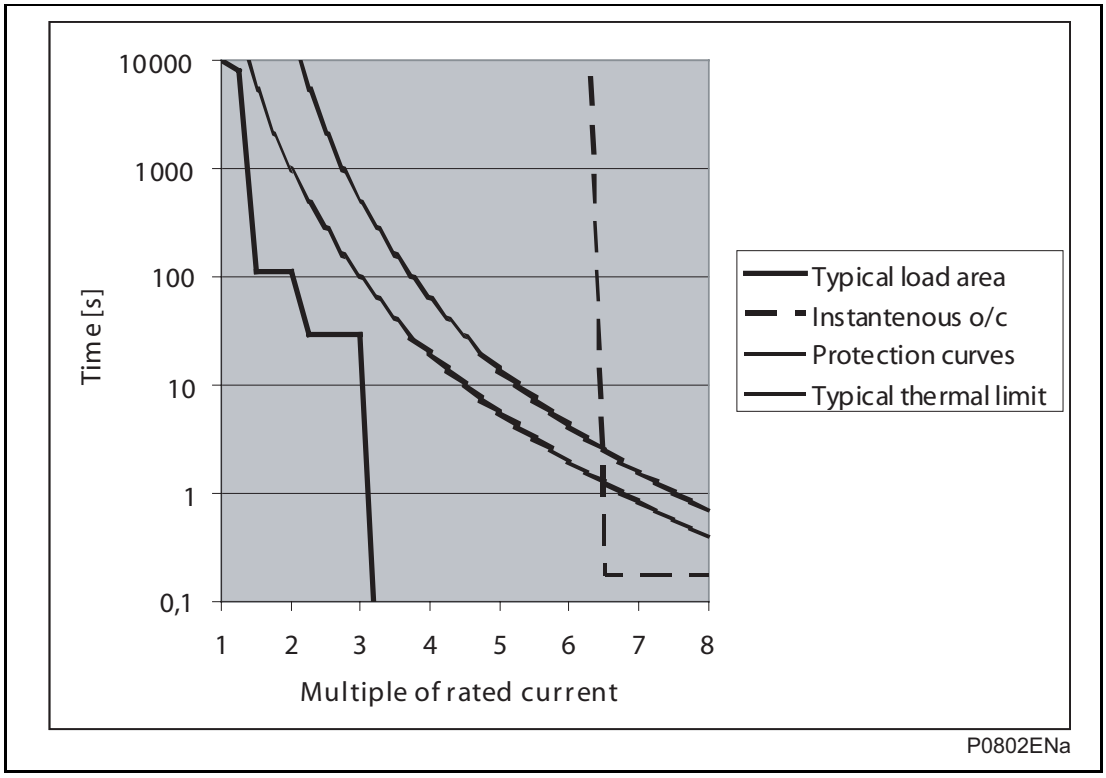

Figure 3: Matching curve to load and thermal limit of rectifier

The rectifier protection feature has been based upon the inverse time/current characteristic as used in the MCTD 01 (Silicon Rectifier Protection Relay) and the above diagram shows a typical application.

The protection of a rectifier differs from the more traditional overcurrent applications in that many rectifiers can withstand relatively long overload periods without damage, typically 150% for 2 hours and 300% for 1 min.

The I> setting should be set to typically 110% of the maximum allowable continuous load of the rectifier. The relay gives start indications when the I> setting has been exceeded, but this is of no consequence, as this function is not used in this application. The rectifier curve should be chosen for the inverse curve as it allows for relatively long overloads even with a 110% I> setting.

Typical settings for the TMS are:

Light industrial service TMS = 0.025

Medium duty service TMS = 0.1

Heavy duty traction TMS = 0.8

The high set is typically set at 8 times rated current as this ensures HV AC protection will distinguish from faults covered by the LV protection. However, it has been known for the high set to be set to 4 or 5 times where there is more confidence in the AC protection. Use of the thermal element to provide protection between 70% and 160% of rated current could enhance the protection. It is also common practice to provide restricted earth fault protection for the transformer feeding the rectifier. See the appropriate section dealing with restricted earth fault protection.

2.3 Earth fault protection

Earth fault (E/F) current is measured on the e/f input.

Depending on the connection on the terminals e/f input can supply the P114D (7 and 9 terminals) or not supply the P114D (8 and 9 terminals).

Two stages are available: IN> and IN>>. The first stage is with IDMT or DT characteristic. The types of characteristics are the same as for I> (refer to 2.1.5).

IDMT reset configuration is common to I> and IN> (refer to 2.1.2).

If e/f CT is connected to 7 and 9 terminals and auxiliary voltage supply is not connected to 11-12 terminals, the current on e/f input should be greater than 0.2 Ien in order to supply the P114D.

2.3.1 Calculation of the required E/F settings

The setting value of E/F overcurrent protection should be greater (with safety margin) than the charging currents flowing in the protected line to prevent an earth fault in other parts of the system tripping the relay. The value of the safety coefficient depends on the application and accuracy of obtained earth fault current value (typically : 1.5 to 2.5).

2.4 External trip

Binary Input can be configured to CB trip. In DIP switches I/O configuration it is necessary to set “Input Set 2” group: DIP Switch Block 1 Number 2 (“**DIP I/O**” / “USB I/O”) **OFF** and input function “L1 - AUX” (DIP Switch Block 7 Number 1 OFF). By using MiCOM S1 setting software after appropriate configuration on the front panel (DIP Switch Block 1 Number 2 (“DIP I/O” / “**USB I/O**”) **ON**: “USB I/O”) it is possible to set AUX function in both Input L1 and Input L2.

AUX function is instantaneous (no time delay setting)

High state of binary input lights up the AUX LED, sets the trip energy on Flag Indicator and Low Energy Trip Coil (if AUX or any trip is mapped to RL1) outputs.

Note: Low Energy Trip Coil output follow RL1 configuration. All criteria mapped to RL1 activate the energy output above.

2.5 Blocked overcurrent protection

Blocked overcurrent protection involves the use of start contacts from downstream relays wired onto blocking inputs of upstream relays. This allows identical current and time settings to be employed on each of the relays involved in the scheme, as the relay nearest to the fault does not receive a blocking signal and hence trips discriminatively. This type of scheme therefore reduces the amount of required grading stages and consequently fault clearance times.

The principle of blocked overcurrent protection may be extended by setting fast acting overcurrent elements on the incoming feeders to a substation which can then be blocked by start contacts from the relays protecting the outgoing feeders. The fast acting element is thus allowed to trip for a fault condition on the busbar but is stable for external feeder faults by means of the blocking signal. This type of scheme therefore provides much reduced fault clearance times for busbar faults than would be the case with conventional time graded overcurrent protection. The availability of multiple overcurrent and earth fault stages means that back-up time graded overcurrent protection is also provided. This is shown in Figures 4 and 5. To block the higher stage I>> to the incomer, input L1 should be used and mapped to the “blocking I>>” function.

At least one of the feeder outputs should be set to start of I>> function.

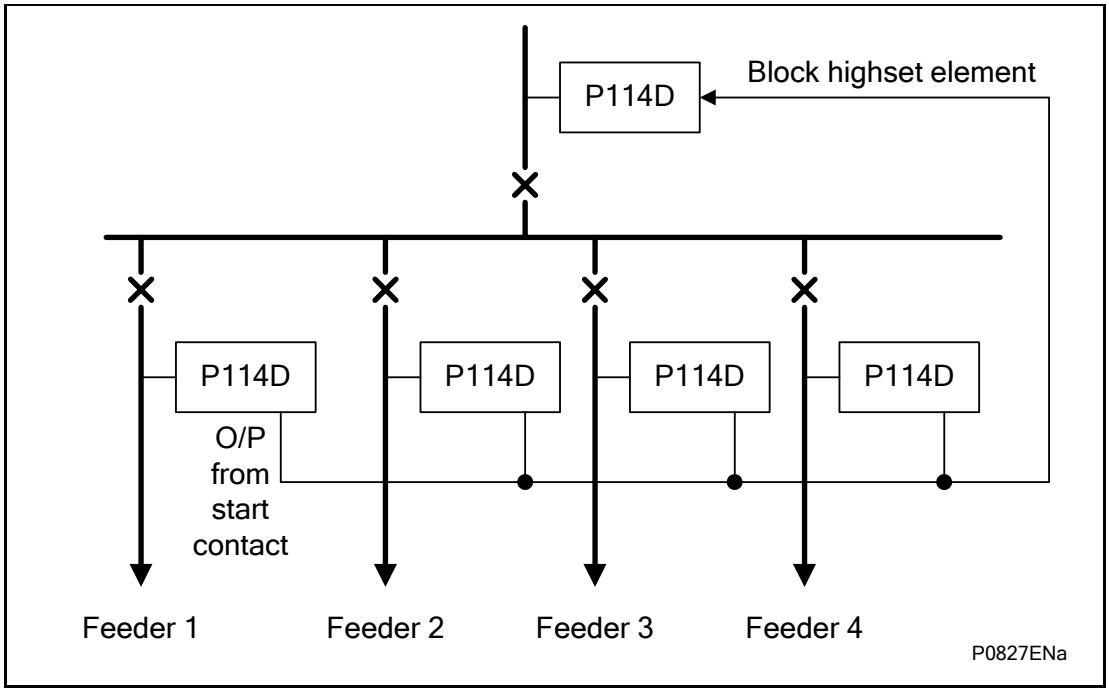

Figure 4: Simple busbar blocking scheme

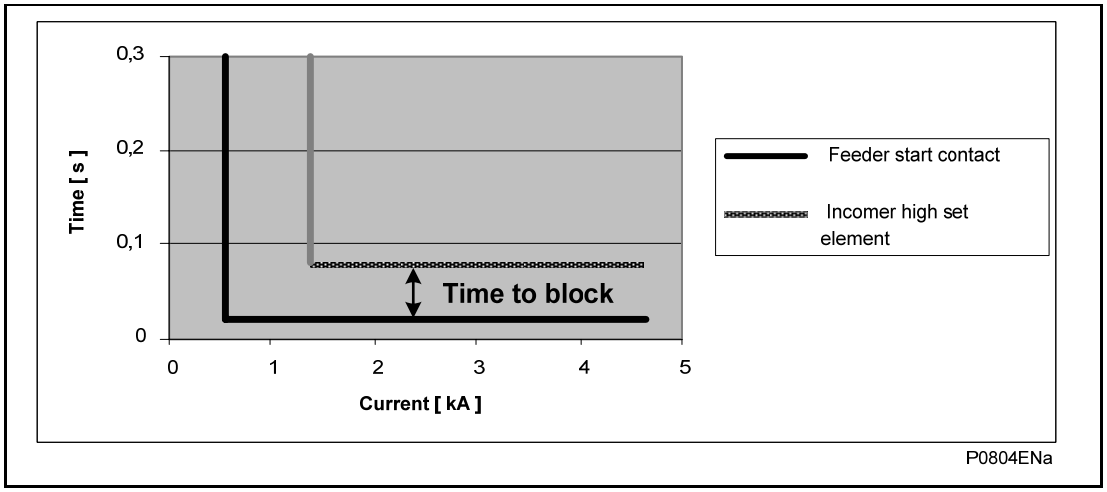

Figure 5: Time grading in the simple busbar blocking scheme.

For further guidance on the use of blocked overcurrent schemes, refer to Schneider Electric.

2.6 Minimum tripping time

The minimum tripping time when the relay is switched on to a fault is subject to the fault current level (Figure 6). This diagram shows the operation time under the worst conditions, these include the inception of the fault from a zero current level, ageing, temperature.

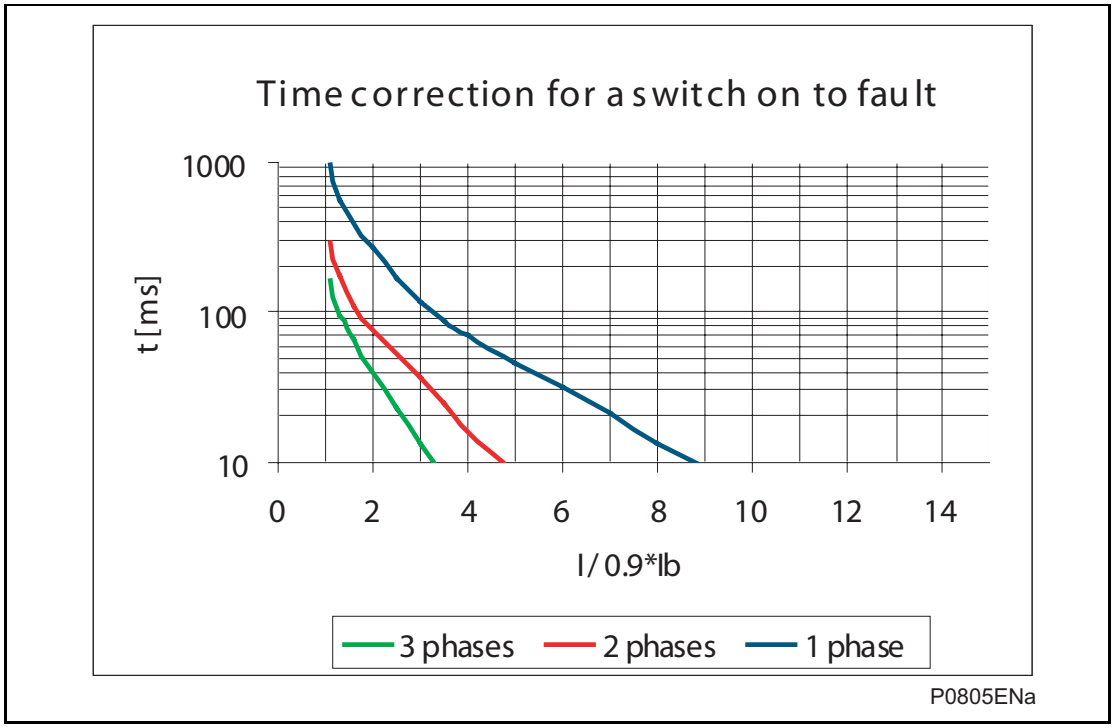

Figure 6: Time correction for a switch on to fault

The minimum tripping of a relay when the current is greater than the 0.2 x In (Ien) fault level ("hot start") can be defined as:

Time delay setting + 35 ms (measuring algorithm time delay).

The minimum setting of the DT time delay is: 0ms for overcurrent and 0ms for earth fault.

The minimum tripping time for the "hot start" (capacitors are charged within the unit) for 0 ms set time delay is: 0 ms + 35 ms = 35 ms

If there was no current flowing through the relay terminals before the occurrence of a fault and a fault condition occurs, the minimum tripping time from the "cold start" (capacitors not charged) with a 40 ms set time delay: 0 ms + 35 ms + time correction value, is shown in Figure 4

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3. CT REQUIREMENTS

The current transformer requirements are based on a maximum prospective fault current of 50 times the relay rated current (In) and the relay having an instantaneous setting of 25 times rated current (In). The current transformer requirements are designed to provide operation of all protection elements.

Where the criteria for a specific application are in excess of those detailed above, or the actual lead resistance exceeds the limiting value quoted, the CT requirements may need to be increased according to the formulae in the following sections:

Nominal Rating	Nominal Output	Accuracy Class	Accuracy Limited Factor	Limiting Lead Resistance
1A	2.5VA	10P	20	1.3 ohms
5A	7.5VA	10P	20	0.11 ohms

3.1 Non-directional definite time/IDMT overcurrent & earth fault protection

3.1.1 Time-delayed phase overcurrent elements

$$V_K \geq I_{cp}/2 * (R_{CT} + R_L + R_{rp})$$

3.1.2 Time-delayed earth fault overcurrent elements

$$V_K \geq I_{cn}/2 * (R_{CT} + 2R_L + R_{rp} + R_{rn})$$

3.2 Non-directional instantaneous overcurrent & earth fault protection

3.2.1 CT requirements for instantaneous phase overcurrent elements

$$V_K \geq I_{sp} \times (R_{CT} + R_L + R_{rp})$$

3.2.2 CT requirements for instantaneous earth fault overcurrent elements

$$V_K \geq I_{sn} \times (R_{CT} + 2R_L + R_{rp} + R_{rn})$$

3.3 Non-directional definite time/IDMT sensitive earth fault (SEF) protection

3.3.1 Non-directional time delayed SEF protection (residually connected)

$$V_K \geq I_{cn}/2 * (R_{CT} + 2R_L + R_{rp} + R_{rn})$$

3.3.2 Non-directional instantaneous SEF protection (residually connected)

$$V_K \geq I_{sn} \times (R_{CT} + 2R_L + R_{rp} + R_{rn})$$

3.3.3 SEF protection - as fed from a core-balance CT

Core balance current transformers of metering class accuracy are required and should have a limiting secondary voltage satisfying the formulae given below:

Non-directional time delayed element:

$$V_K \geq I_{cn}/2 * (R_{CT} + 2R_L + R_{rn})$$

Non-directional element:

$$V_K \geq I_{sn} \times (R_{CT} + 2R_L + R_{rn})$$

AP

Note that, in addition, it should be ensured that the phase error of the applied core balance current transformer is less than 90 minutes at 10% of rated current and less than 150 minutes at 1% of rated current.

Abbreviations used in the previous formulae are explained below:

Where:

V_K	=	Required CT knee-point voltage (volts)
I_{fn}	=	Maximum prospective secondary earth fault current (amps)
I_{fp}	=	Maximum prospective secondary phase fault current (amps)
I_{cn}	=	Maximum prospective secondary earth fault current or 31 times I> setting (whichever is lower) (amps)
I_{cp}	=	Maximum prospective secondary phase fault current or 31 times I> setting (whichever is lower) (amps)
I_{sn}	=	Stage 2 earth fault setting (amps)
I_{sp}	=	Stage 2 setting (amps)
R_{CT}	=	Resistance of current transformer secondary winding (ohms)
R_L	=	Resistance of a single lead from relay to current transformer (ohms)
R_{rp}	=	Impedance of relay phase current input at 30In (ohms)
R_{rn}	=	Impedance of the relay neutral current input at 30In (ohms)

4. AUXILIARY SUPPLY FUSE RATING

In the Safety section of this manual, the maximum allowable fuse rating of 16 A is quoted. To allow time grading with fuses upstream, a lower fuse link current rating is often preferable. Use of standard ratings of between 6 A and 16 A is recommended. Low voltage fuse links, rated at 250 V minimum and compliant with IEC60269-2 general application type gG are acceptable, with high rupturing capacity. This gives equivalent characteristics to HRC "red spot" fuses type NIT/TIA often specified historically.

The table below recommends advisory limits on relays connected per fused spur. This applies to MiCOM P114D**,** as these have inrush current limitation on switch-on, to conserve the fuse-link.

Maximum Number of MiCOM P114D Relays Recommended Per Fuse				
Battery Nominal Voltage	6A	10 A Fuse	15 or 16 A Fuse	Fuse Rating > 16 A
24 to 48 V ac/dc	2	4	6	Not permitted
60 to 240 Vac/ 60 to 250 Vdc	6	10	16	Not permitted

Alternatively, miniature circuit breakers (MCB) may be used to protect the auxiliary supply circuits.

AP

MEASUREMENTS AND RECORDING

MR

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

MR

CONTENTS

MR

1. MEASUREMENTS AND RECORDING

1.1 Introduction

The P114D is equipped with integral fault recording facilities suitable for analysis of complex system disturbances. Fault records can be read out by setting software MiCOM S1 via the USB port accessible on the P114D front panel. The USB port offers a communications facility to the P114D.

Communication via USB port can be established if P114D is not supplied by current via CT or Auxiliary voltage supply.

Access to the USB port is protected by means of a plastic cover.

1.2 Event records

The relay records and time tags up to 100 events and stores them in non-volatile FRAM memory. This enables the system operator to establish the sequence of events that occurred within the relay following a particular power system condition, switching sequence etc. When the available space is exhausted, the oldest event is automatically overwritten by the most recent.

The real time clock within the relay provides the time tag for each event, to a resolution of 1ms.

The event records are available for remote viewing, via the communications ports RS485 or USB.

For extraction from a remote source via communications ports, refer to the SCADA Communications section (P114D/EN CT), where the procedure is fully explained.

1.2.1 Types of event

An event may be a change of state of a control input or output relay, a trip condition, etc. The following sections show the various items that constitute an event:

1.2.2 Change of state of opto-isolated inputs:

If one or more of the opto (logic) inputs has changed state since the last time that the protection algorithm ran, the new status is logged as an event. The information is available if the event is extracted and viewed via PC.

1.2.3 Change of state of one or more output relay contacts:

If one or more of the output relay contacts have changed state since the last time that the protection algorithm ran, then the new status is logged as an event. The information is available if the event is extracted and viewed via PC.

1.2.4 Relay alarm conditions

Any alarm conditions generated by the relays will also be logged as individual events. The following table shows examples of some of the alarm conditions and how they appear in the event list:

Alarm Condition	Event Text	Event Value
Auxiliary Supply Fail	Vx Fail ON/OFF	Bit position 0 in 32 bit field
CT Supply Fail	CT Supply Fail ON/OFF	Bit position 1 in 32 bit field

The above table shows the abbreviated description that is given to the various alarm conditions and also a corresponding value between 0 and 31. This value is appended to each alarm. It is used by the event extraction software, such as MiCOM S1, to identify the alarm. Either ON or OFF is shown after the description to signify whether the particular condition is actual or has reset.

1.2.5 Protection element trips

Any operation of protection elements,(a trip condition) will be logged as an event record, consisting of a text string indicating the operated element and an event value. Again, this value is intended for use by the event extraction software, such as MiCOM S1.

1.3 Fault records

Each fault record is generated without time stamp.

The following data is recorded for any relevant elements that operated during a fault, and can be viewed in each of the last 5 fault records:

(i) Event Text (the reason for a trip):

Phase Overcurrent:
- I> trip
- I>> trip
- IN> trip
- IN>> trip
- AUX trip

(ii) Event Value:

Per phase record of the current value during the fault: Iφ and measured IN

Fault records are stored in non-volatile memory (FRAM memory). This type of memory does not require any maintenance (no battery inside the P114D). Fault records are stored without any time limitation even if the P114D is not supplied from any power source.

1.4 Measurements

The relay produces a variety of directly measured power system quantities:

IA, IB, IC - True RMS value in range up to 20th harmonic

IN - measured fundamental harmonic only (E/F analogue input)

Above quantities are used by the protection criteria and by the fault recorder.

COMMISSIONING

CM

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

CM

CONTENTS

CM

1. INTRODUCTION

The MiCOM P114D feeder protection relays are fully numerical in design, implementing all protection and non-protection functions in software. The relays employ a high degree of self-checking. The commissioning tests do not need to be as extensive as with non-numeric electronic or electro-mechanical relays.

In the commissioning of numeric relays, it is only necessary to verify that the hardware is functioning correctly and that the application-specific software settings have been applied to the relay. It is considered unnecessary to test every function of the relay if the settings have been verified by one of the following methods:

- Extracting the settings applied to the relay using appropriate setting software (preferred method)
- Via the operator interface (DIP switches)

Unless previously agreed to the contrary, the customer will be responsible for determining the application-specific settings applied to the relay and for testing of any scheme logic applied by external wiring.

Blank commissioning test and setting records are provided at the end of this chapter for completion as required.

Before carrying out any work on the equipment, the user should be familiar with the contents of the safety guide SFTY/4L M/E11 or later issue, or the safety and technical data section of the technical manual and also the ratings on the equipment rating label.

For safety reasons, no work must be carried out on the P114D until all power sources to the unit have been disconnected.

2. SETTING FAMILIARIZATION

When commissioning a MiCOM P114D relay for the first time, sufficient time should be allowed to enable the user to become familiar with the method by which the settings are applied.

The Getting Started section (P114D/EN GS) contains a detailed description of the P114D relay.

All the protection elements' settings can be changed by using DIP switches (refer to chapter P114D/EN ST of this manual)

Alternatively, if a portable PC is available together with suitable setting software (MiCOM S1), the settings can be viewed a page at a time to display a full column of data and text. This PC software does not allow the user to download protection settings from the PC into the P114D via the USB port. Protection setting of the P114D can only be done via the DIP switches. But after it has been set, a readout can be saved to a file on disk for future reference or printed to produce a setting record. I/O configuration can be made via DIP switches or via setting software (MiCOM S1). Refer to the PC software user manual for details.

In the P114D's memory there are three input setting (configuration) groups: two fixed for DIP switch configuration ("Input GROUP 1" and "Input GROUP 2") and one ("Input GROUP 3") for setting software configuration (via USB port) which allows all inputs to be freely configured for available functions.

Switching between DIP switch configuration ("Input GROUP 1" and "Input GROUP 2") and setting software configuration (third input setting group) is possible on the front panel of the relay: "Configuration" DIP Switch Block 1 switch number 2 ("DIP I/O" / "USB I/O").

If the inputs' configuration is applied via a DIP switch ("DIP I/O"), switching between the first and the second setting group is made via DIP Switch Block 7 Number 1 ("L1-block. I>>" / "L1 - AUX").

The same rules apply for the outputs' configuration. Three output setting groups are stored in the memory. The first two ("Output GROUP 1" and "Output GROUP 2") are fixed, changeable via DIP Switch Block 7 Number 2 ("RL – GROUP 1" / "RL – GROUP 2"). The third output group ("Output GROUP 3") is set via software configuration, which gives more flexibility for configuration or is the factory default (if unchanged).

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Switching between DIP switch configuration (the first and the second output setting group) and setting software configuration (third output setting group) is possible on the front panel of relay: DIP Switch Block 1 Number 2 ("DIP sw. I/O" / "USB I/O").

Switching between "DIP sw. I/O" and "USB I/O" configuration is common to input and output configuration.

(For further details refer to chapter P114D/EN ST of this manual)

If the software is being used for the first time, allow sufficient time to become familiar with its operation.

3. EQUIPMENT REQUIRED FOR COMMISSIONING

3.1 Minimum equipment required

Multifunctional dynamic current injection test set.

Multimeter with suitable ac current range.

WARNING – ENSURE THAT THE MULTIMETER FUSE IS NOT OPEN CIRCUIT IF USING FOR CT CURRENT MEASUREMENT.

Multimeter with recording of maximum value of dc voltage (for dc amplitude of pulse tripping measurement).

Continuity tester (if not included in multimeter).

Note: Modern test equipment may contain many of the above features in one unit.

4. PRODUCT CHECKS

These product checks cover all aspects of the relay and should be carried out to ensure that the unit has not been physically damaged prior to commissioning, is functioning correctly and that all input quantity measurements are within the stated tolerances.

If the application-specific settings have been applied to the relay prior to commissioning, it is advisable to make a copy of the settings to allow their restoration later. This could be done by:

- Obtaining a setting file from the customer.
- Extracting the settings from the relay itself (this again requires a portable PC with appropriate setting software)
- Manually creating a setting record. This could be done using a copy of the setting record located at the end of this chapter, to record the settings, as the relay's menu is scrolled through sequentially via the front panel user interface.

DIP switches are protected against unauthorized changes, by a plastic cover. This plastic cover can be secured by means of a screw or sealed.

4.1 With the relay de-energized

The following group of tests should be carried out without powering the P114D and with the trip circuit and flag indicator isolated.

The current transformer connections must be isolated from the relay for these operations to be carried out.

Never open circuit the secondary circuit of a current transformer since the high voltage produced may be lethal and could damage insulation.

The line current transformers should be short-circuited and disconnected from the relay terminals, using the isolating trip circuit and flag indicator provided. If this is not possible when carrying out this operation, the wiring to these circuits must be disconnected and the exposed ends suitably short- circuited to prevent a safety hazard.

4.1.1 Visual inspection

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The rating information given under the top access cover on the front of the relay should be checked. Check that the relay being tested is correct for the protected line/circuit. Ensure that the circuit reference and system details are entered onto the setting record sheet. Double-check the CT primary current rating, and be sure to record the actual CT setting used.

Carefully examine the relay to check that no physical damage has occurred since installation.

4.1.2 Insulation

Insulation resistance tests are only necessary during commissioning and if they have not been performed during installation.

Isolate all wiring from the earth and test the insulation with an electronic or brushless insulation tester at a dc voltage not exceeding 500 V. Terminals of the grouped circuits should be temporarily connected together.

The main groups of relay terminals are:

a) Current transformer circuits,

b) Trip coil and flag indicator outputs

c) Auxiliary voltage supply

d) Opto-isolated control inputs (L1 and L2: one circuit)

e) Relay contacts

f) EIA(RS)485 communication port

g) Case earth

The insulation resistance should be greater than 100 MΩ at 500 V.

On completion of the insulation resistance tests, ensure all external wiring is correctly reconnected to the relay.

4.1.3 External wiring

Check that the external wiring is correct when compared to the relevant relay and scheme diagram. Ensure as far as practical that the phase sequence is as expected. The relay diagram number appears on the rating label on the upper side of the case.

The connections should be checked against the scheme (wiring) diagram.

4.1.4 Auxiliary supply voltage (Vx)

The relay can be operated from either a dc only or ac/dc auxiliary supply depending on the relay's nominal supply rating. The incoming voltage must be within the operating range specified in Table 1.

Without energizing the relay measure the auxiliary supply to ensure it is within the operating range.

Nominal Supply Rating dc [ac rms]		dc Operating Range	ac Operating Range
24 - 48 V	[24 - 48 V]	19 to 58 V	19 to 53 V
60 - 250 V	[60 - 240 V]	48 to 300 V	48 to 265 V

Table 1: Operational range of auxiliary supply Vx

It should be noted that the relay can withstand an ac ripple of up to 12% of the upper rated voltage on the dc auxiliary supply.

Do not energize the relay or interface unit using the battery charger with the battery disconnected as this can irreparably damage the relay's power supply circuitry.

Energize the relay only if the auxiliary supply is within the specified operating ranges. If a test block is provided, it may be necessary to link across the front of the test plug to connect the auxiliary supply to the relay.

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Note: Vx nominal supply rating is common to auxiliary voltage supply and opto-isolated control inputs

4.2 With the relay energized

The following group of tests verify that the relay hardware and software are functioning correctly and should be carried out while the P114D is powered.

MV isolators should be opened and the MV side should be connected to the earth to allow safe operation of the CB.

4.2.1 Light emitting diodes (LEDs)

On power up the green LED should light up and stay on indicating that the relay is healthy. The relay has non-volatile memory which remembers the state (on or off) of the alarm, trip and, if configured to latch, LED indicators when the relay was last energized from an auxiliary supply. Therefore these indicators may also light up when the auxiliary supply is applied.

Latching of LEDs can be configured via MiCOM S1 setting software (USB port).

Default configuration of LEDs latching:

- P114D ordering option with auxilairy voltage supply: with latching up to reset via Binary Input appropriately configured or via communication port

- P114D ordering option without auxiliary voltage supply: without latching

Note: Above default cofiguration can be changed via the MiCOM S1 setting software (USB port)

There are seven LEDs on the front panel of the relay:

- The green “Healthy” LED indicates that the P114D is powered and no internal faults are detected.

- Red LED “I>” : The timer of the first stage of phase o/c criteria has elapsed.

- Red LED “I>>” : The timer of the second stage of phase o/c criteria has elapsed.

- Red LED “IN>” : The timer of the first stage of e/f criteria has elapsed.

- Red LED “IN>>” : The timer of the second stage of e/f criteria has elapsed.

- Red LED “AUX” : The AUX function activated via opto-isolated control input is configured to this function.

After establising a connection between PC and P114D via USB port, the green “Healthy” LED should be lit permanently (it means that the P114D is powered), even if P114D is not connected to auxiliary voltage supply.

The remaining LEDs can be checked via “LEDs Reset” function. This function depends on L2 input in “Input GROUP 1” and “Input GROUP 2”: Switch Block 1 Number 2 (“**DIP I/O**” / USB I/O”). is in **OFF** position (“DIP I/O”).

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Ensuring that the correct opto input L2 (terminals 14 and 15) nominal voltage is applied and correct polarity, connect the field supply voltage to the appropriate terminals for the input being tested;

Note: All red LEDs should be lit within 1 s.

4.2.2 Input opto-isolators

This test checks that all the opto-isolated inputs on the relay are functioning correctly.

The opto-isolated inputs should be energized one at a time, see external connection diagrams (P114D/EN IN) for terminal numbers.

P114D has no display to see the state of opto-isolated control inputs. In order to see the actual state of opto-isolated control input, MiCOM S1/S&R Modbus/ Measurement Viewer software can be used. Refer to the MiCOM S1 software user manual for details.

If it is not possible to use Measuring Viewer software, it is necessary to check binary inputs by means of a functional test of the entire configuration.

Ensuring that the correct opto input nominal voltage is applied and correct polarity, connect the field supply voltage to the appropriate terminals for the input being tested

Note: The opto-isolated inputs may be energized from an external dc auxiliary supply (e.g. the station battery) in some installations. Check that this is not the case before connecting the field voltage, otherwise damage to the relay may result. If an external 24/27 V, 30/34 V, 48/54 V, 110/125 V, 220/250 V supply is being used it will be connected directly to the relays optically isolated inputs. If an external supply is being used then it must be energized for this test but only if it has been confirmed that it is suitably rated with less than 12% ac ripple.

4.2.3 Output relays

To check output contacts it is necessary to carry out a functional test of the entire configuration.

Note: It should be ensured that thermal ratings of anything connected to the output relays during the contact test procedure, are not exceeded by the associated output relay being operated for too long. It is therefore advised that the time between application and removal of the contact test is kept to the minimum.

4.2.4 Rear communications port

This test should only be performed where the relay is to be accessed from a remote location and will vary depending on the communications standard being adopted.

It is not the intention of the test to verify the operation of the complete system from the relay to the remote location, just the relay's rear communications port and any protocol converter necessary.

4.2.4.1 IEC60870-5-103 (VDEW) communications

IEC60870-5-103/VDEW communication systems are designed to have a local Master Station and this should be used to verify that the relay's EIA(RS)485 port, as appropriate, is working.

The relay address and baud rate settings for EIA(RS)485 can be set using local communication via USB port (setting software).

Then ensure that the relay address and baud rate settings in the application software are the same as those set via USB port.

Check that, using the Master Station, communications with the relay can be established.

4.2.4.2 MODBUS communications

Connect a portable PC running the appropriate MODBUS Master Station software to the relay's first rear EIA(RS)485 port via an EIA(RS)485 to EIA(RS)232 interface converter. The terminal numbers for the relays EIA(RS)485 port are up to 31.

The relay address, Parity and Baud Rate settings for EIA(RS)485 are set using local communication via USB port (MiCOM S1 software).

Then ensure that the relay address and baud rate settings in the application software are the same as those set via USB port.

Check that communications with this relay can be established.

4.2.5 Current inputs

This test verifies that the accuracy of current measurement is within the acceptable tolerances.

P114D measures True RMS value up to the 20th harmonic.

Apply current equal to the line current transformer secondary winding rating to each current transformer input of the corresponding rating in turn, see Table 1 or external connection diagram (P114D/EN IN) for appropriate terminal numbers, checking its magnitude using a multimeter/test set readout. The corresponding reading can then be checked in MiCOM S1 / S&R Modbus / Measurement Viewer connected with P114D via USB port. Refer to the PC software user manual for details.

If it is not possible to use MiCOM S1, it is necessary to test protection stages to measure the accuracy of analogue inputs.

The measurement accuracy of the relay:

Phase current

For current: 0.2 to 4.7 In :
Accuracy: ±.5% of reading

For current: 4.7 to 20 In:
Accuracy: ±.10% of reading

Earth fault current

For current: minimum setting value to 0.2 Ien:
Accuracy: ±.10% of reading

For current: 0.2 to 2 Ien:
Accuracy: ±.5% of reading

For current: 2 Ien to maximum setting value:
Accuracy: ±.10% of reading

However, an additional allowance must be made for the accuracy of the test equipment being used.

5. SETTING CHECKS

The setting checks ensure that all of the application-specific relay settings (i.e. the relay's function), for the particular installation, have been correctly applied to the relay.

Note: The trip circuit should remain isolated during these checks to prevent accidental operation of the associated circuit breaker.

5.1 Apply application-specific settings

Setting of the protection elements can be done via DIP switches only.

Enter settings manually via the relay's DIP switch interface.

I/O configuration can be made via DIP switches or via setting software (MiCOM S1)

As a first step it is necessary to check Input and Output configuration made via "Configuration" DIP switches (refer to P114D/EN ST/A11) *(Switch Block: 1 and 7)*.

Note: All settings are given as multiples of In (Ien).

Once this is done, the remaining settings should be checked:

- *The time delay setting for the second stage element tI>>*
  (Switch Block 2 Number: 1 to 6)
- *The current setting for the second stage element (I>>)*
  (Switch Block 3 Number: 1 to 6)
- *The time characteristic setting (I> CHAR) for the first stage element I>*
  (Switch Block 4 Number: 1 to 4)
- *The time delay setting for the first stage element tI>*
  (Switch Block 5 Number: 1 to 8)
- *The current stage setting for the first overcurrent protection I>*
  (Switch Block 6 Number: 1 to 6)
- *The time delay setting for the earth fault protection tIN>>*
  (Switch Block 8 Number: 1 to 6)
- *The current setting for the earth fault protection (IN>>)*
  (Switch Block 9 Number: 1 to 6)
- *The time characteristic setting (IN> CHAR) for the first stage element IN>*
  (Switch Block 10 Number: 1 to 4)
- *The time delay setting for the first stage element tNI>*
  (Switch Block 11 Number: 1 to 8)
- *The current stage setting for the first overcurrent protection IN>*
  (Switch Block 12 Number: 1 to 6)

Downloading the relay settings to a file or printout can be achieved using a portable PC running the appropriate software connected to the USB port (archiving of specific settings)

Application notes for the setting values are given in chapter P114D/EN AP of this manual.

5.2 Demonstrate correct relay operation

The above tests have already demonstrated that the relay is within calibration, thus the purpose of these tests is as follows:

- To determine that the primary protection functions of the relay, overcurrent, earth-fault etc. can trip according to the correct application settings.
- To verify correct assignment of the trip outputs and flag indicator outputs, by monitoring the response to a selection of fault injections.

5.2.1 Overcurrent protection testing

This test, performed on stage 1 of the overcurrent protection function, demonstrates that the relay is operating correctly at the application-specific settings.

5.2.1.1 Connection and preliminaries

The testing current is fed via terminals: terminals: 1-2, 3-4, 5-6,7-8-9 connected to CTs. The type of connection is shown in Figure 1. The external connection diagram is also on the front panel of the P114D.

Ensure that I> is configured to RL1 output.

Note: Low Energy Trip Output is activated by the same protection criteria as RL1 output, so RL1 has to be configured appropriately.

Disconnect auxiliary voltage supply from P114D terminals (11 and 12).

Connect the trip output or flag indicator output so that its operation will trip the test set and stop the timer.

Note: During tripping, the trip and flag indicator outputs have the following energy output values:
- Trip coil output: 0.1 J 24 Vdc or 0.02 J 12 V (ordering option)
- Flag indicator output: 0.01 J 24 Vdc

The timer should be compatible with the above outputs

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Connect the current output of the test set to the “A” phase the current transformer input of the relay (terminals 1 and 2).

Ensure that the timer will start when the current is applied to the relay.

5.2.1.2 Perform the test

Ensure that the timer is reset.

Apply a current of twice the setting in DIP switches: I> to the relay (refer to chapter P114D/EN ST of this manual) and note the time displayed when the timer stops.

WARNING: NEVER OPEN-CIRCUIT THE SECONDARY CIRCUIT OF A CURRENT TRANSFORMER SINCE THE HIGH VOLTAGE PRODUCED MAY BE LETHAL AND COULD DAMAGE INSULATION.

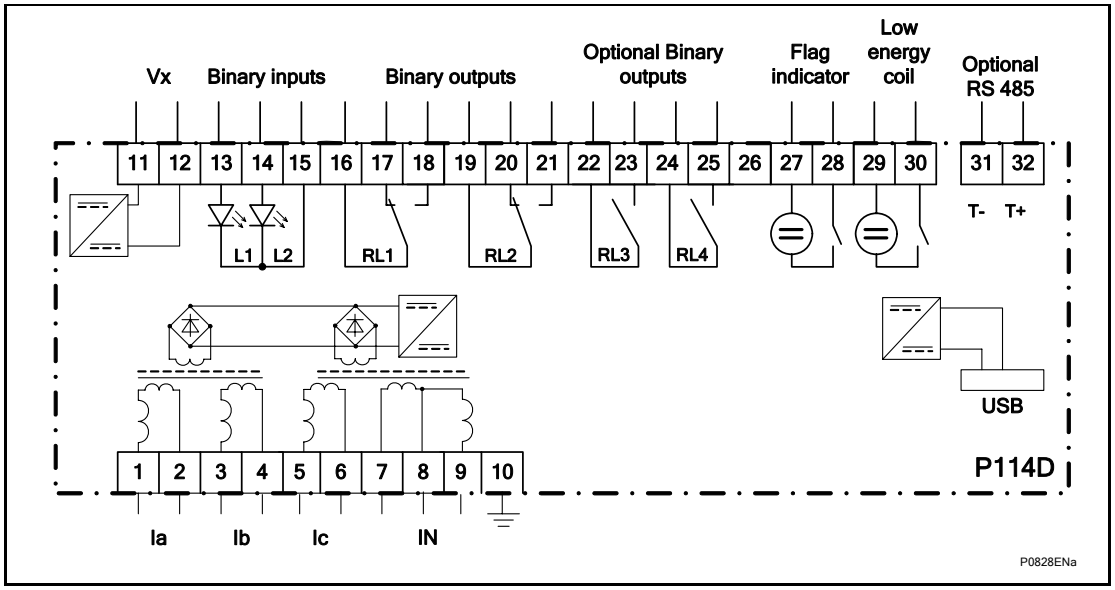

Figure 1: P114D external connection diagram

5.2.1.3 Check the operating time

Check that the operating time recorded by the timer is within the range shown in Table 2.

Note: Except for the definite time characteristic, the operating times given in Table 2 are for a time multiplier or time dial setting of 1. Therefore, to obtain the operating time for other time multipliers or time dial settings, the time given in Table 2 must be multiplied by the setting for IDMT characteristics.

In addition, for definite time and inverse characteristics there is an additional delay of up to 0.03 second that may need to be added to the relay's acceptable range of operating times.

If P114D is not connected to auxiliary voltage supply (Vx) it is necessary to add additional start-up time delay. The value of this delay depends on the ratio: value current/0.2In. Refer to application chapter of this manual (P114D/EN AP) or technical data chapter of this manual (P114D/EN TD)

For all characteristics, allowance must be made for the accuracy of the test equipment being used.

Characteristic	Operating Time at Twice Current Setting and Time Multiplier/Time Dial Setting of 1.0	
	Nominal (Seconds)	Range (Seconds)
DT	tI> Time Delay Setting	Setting ±5%
IEC S Inverse	10.03	9.03 - 11.03
IEC V Inverse	13.50	12.12 - 14.85
IEC E Inverse	26.67	24.00 - 29.30
UK LT Inverse	120.00	108.00 - 132.00
UK ST Inverse	1.78	1.61 – 1.95
IEEE M Inverse	3.8	3.42 - 4.18
IEEE V Inverse	7.03	6.32 - 7.73
IEEE E Inverse	9.52	8.57 – 10,47

Characteristic	Operating Time at Twice Current Setting and Time Multiplier/Time Dial Setting of 1.0	
	Nominal (Seconds)	Range (Seconds)
US Inverse	2.16	1.94 - 2.37
US ST Inverse	12.12	10.90 - 13.33
RI Inverse	4.52	4.07-4.97

Table 2: Characteristic operating times for I>

Reconfigure to test a B phase fault. Repeat the test in section 5.2.1.2, this time ensuring that the breaker trip output relative to B phase operation trips correctly. Record the phase B trip time. Repeat for C phase fault.

5.2.1.4 Check the outputs

5.2.1.4.1 CB coil output

Ensure that the CB coil is connected to terminals 29 and 30.

Ensure that I> stage is configured to RL1 output (refer to chapter P114D/EN ST of this manual)

Close the CB.

Connect a multimeter with maximum dc voltage value recording on terminals 29 and 30.

Apply a current of twice the setting in DIP switches: I> to the relay. The CB will open when the tI> time delay elapses.

Record the maximum voltage value measured by the multimeter. The value should be greater than:

(i) 24 Vdc to 26.4 Vdc: for ordering option 24 Vdc 0.1 J

(ii) 12 Vdc to 13.2 Vdc: for ordering option 12 Vdc 0.02 J

P114D should trip CB.

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5.2.1.4.2 Flag indicator output

Ensure that the Flag indicator is connected to terminals 27 and 28.

Reset the Flag indicator.

Connect a multimeter with maximum dc voltage value recording to terminals 27 and 28.

Apply a current of twice the setting in the DIP switches: I> to the relay. The Flag indicator will be triggered when the tI> time delay elapses.

Record the maximum voltage value measured by the multimeter.

The value should be: 24 Vdc to 26.4 Vdc.

Flag indicator should be tripped.

6. COMMISSIONING TEST RECORD

Date:		Engineer:	
Station:		Circuit:	
		System Frequency:	Hz

P114D Front Plate Information

Overcurrent protection relay	**MiCOM P114D**
Model number	
Serial number	

Test Equipment Used

This section should be completed to allow future identification of protective devices that have been commissioned using equipment, that is later found to be defective or incompatible, but may not be detected during the commissioning procedure.

Injection test set	Model: Serial No:	
Insulation tester	Model: Serial No:	
Setting software:	Type: Version:	

*Delete as appropriate

Have all relevant safety instructions been followed? Yes* ☐ No* ☐

1.	**Product Checks**	
1.1	**With the relay de-energized**	
1.1.1	Visual inspection	
1.1.1.1	Relay damaged?	Yes* ☐ No* ☐
1.1.1.2	Rating information correct for installation?	Yes* ☐ No* ☐
1.1.1.3	Case earth installed?	Yes* ☐ No* ☐
1.1.2	Insulation resistance >100 MΩ at 500 Vdc	Yes* ☐ No* ☐ Not Tested* ☐
1.1.3	External wiring	
1.1.3.1	Wiring checked against diagram?	Yes* ☐ No* ☐
1.1.4	Measured auxiliary voltage supply	_____ V ac*

CM

1.2 **With the relay energized**

1.2.1	Light emitting diodes	
1.2.1.1	Connect auxiliary voltage supply to terminals 11 and 12. Green “Healthy” LED working?	Yes* ☐ No* ☐
1.2.1.2	Supply P114D with current above self powering level (0.2In). Green “Healthy” LED working?	Yes* ☐ No* ☐
1.2.1.3	Establish connection between PC and P114D via USB port. Green “Healthy” LED working?	Yes* ☐ No* ☐
1.2.1.4	Reset LEDs via Binary input L2 or via MiCOM S1 setting software. Red “I>” LED short flashing?	Yes* ☐ No* ☐
1.2.1.5	Reset LEDs via Binary input L2 or via MiCOM S1 setting software. Red “I>>” LED short flashing?	Yes* ☐ No* ☐
1.2.1.6	Reset LEDs via Binary input L2 or via MiCOM S1 setting software. Red “IN>” LED short flashing?	Yes* ☐ No* ☐
1.2.1.7	Reset LEDs via Binary input L2 or via MiCOM S1 setting software. Red “IN>>” LED short flashing?	Yes* ☐ No* ☐
1.2.1.8	Reset LEDs via Binary input L2 or via MiCOM S1 setting software. Red “AUX” LED short flashing?	Yes* ☐ No* ☐
1.2.2	Inputs	
1.2.2.1	Auxiliary voltage for opto-isolated control inputs: Value measured	_____ Vdc
1.2.2.2	L1 binary input working?	Yes* ☐ No* ☐
1.2.2.3	L2 binary input working?	Yes* ☐ No* ☐
1.2.3	Outputs	
1.2.3.1	Output Relays	
1.2.3.1.1	Relay 1 working?	Yes* ☐ No* ☐
1.2.3.1.2	Relay 2 working?	Yes* ☐ No* ☐
1.2.3.1.3	Relay 3 working?	Yes* ☐ No* ☐ N/A* ☐
1.2.3.1.4	Relay 4 working?	Yes* ☐ No* ☐ N/A* ☐
1.2.3.2	Maximum voltage value measured on Low Energy Tripping Coil output (29 and 30) during trip signal (note: 50ms pulse signal)	_____ Vdc
1.2.3.3	Maximum voltage value measured on Flag Indicator output (27 and 28) during trip signal (note: 50ms pulse signal)	_____ Vdc
1.2.3.4	Close CB, after which apply current above setting value. CB has opened?	Yes* ☐ No* ☐
1.2.4	Communications between PC and MiCOM S1 setting software established?	Yes* ☐ No* ☐

2. Setting Checks

2.1	Protection function timing tested?	Yes* ☐ No* ☐
	Applied current	_____ A
	Expected operating time	_____ s
	Measured operating time	_____ s

3. Final Checks

3.1	All test equipment, leads, shorts and test blocks removed safely?	Yes* ☐ No* ☐
3.2	Disturbed customer wiring re-checked?	Yes* ☐ No* ☐ N/A* ☐
3.3	All commissioning tests disabled?	Yes* ☐ No* ☐
3.4	Fault records reset (via S1 software)?	Yes* ☐ No* ☐

COMMENTS #
(# Optional, for site observations or utility-specific notes).

Commissioning Engineer

Customer Witness

Date:

Date:

7. SETTING RECORD

Date:		Engineer:	
Station:		Circuit:	
		System Frequency:	Hz
		CT Ratio (tap in use):	/ A

Front Plate Information

Overcurrent protection relay	**MiCOM P114D**
Model number	
Serial number	
Rated phase current In	
Rated e/f current Ien	

7.1 Settings readout from Front Plate of P114D

DIP Switch Block 1 Switch Number: 1	Config. Time Delay Reset for IDMT characteristic	Switch Number 1: ON* ☐ OFF* ☐ Setting value (refer to P114S/EN ST/A11) readout on P114D front panel:
DIP Switch Block 1 Switch Number: 2	Config. I/O configuration	Switch Number 2: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel:
DIP switch block: 2 Switch number: 1-6	tI>> (Tripping time of definite time short-circuit overcurrent element)	Switch Number 1: ON* ☐ OFF* ☐ Switch Number 2: ON* ☐ OFF* ☐ Switch Number 3: ON* ☐ OFF* ☐ Switch Number 4: ON* ☐ OFF* ☐ Switch Number 5: ON* ☐ OFF* ☐ Switch Number 6: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel: s

CM

DIP switch block: 3 Switch number: 1-6	I>> (Short-circuit overcurrent protection)	Switch number 1: ON* ☐ OFF* ☐ Switch number 2: ON* ☐ OFF* ☐ Switch number 3: ON* ☐ OFF* ☐ Switch number 4: ON* ☐ OFF* ☐ Switch number 5: ON* ☐ OFF* ☐ Switch number 6: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel: xIn
DIP switch block: 4 Switch number: 1-4	I> CHAR. (Type of characteristic for the 1st stage of overcurrent element: I>)	Switch number 1: ON* ☐ OFF* ☐ Switch number 2: ON* ☐ OFF* ☐ Switch number 3: ON* ☐ OFF* ☐ Switch number 4: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel: type of characteristic
DIP switch block: 5 Switch number: 1-8	tI> / TMS / TD (Tripping time of definite time overcurrent element)	Switch Number 1: ON* ☐ OFF* ☐ Switch Number 2: ON* ☐ OFF* ☐ Switch Number 3: ON* ☐ OFF* ☐ Switch Number 4: ON* ☐ OFF* ☐ Switch Number 5: ON* ☐ OFF* ☐ Switch Number 6: ON* ☐ OFF* ☐ Switch Number 5: ON* ☐ OFF* ☐ Switch Number 6: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel:
DIP Switch Block: 6 Switch Number: 1-6	I> (First current stage of overcurrent protection)	Switch number 1: ON* ☐ OFF* ☐ Switch number 2: ON* ☐ OFF* ☐ Switch number 3: ON* ☐ OFF* ☐ Switch number 4: ON* ☐ OFF* ☐ Switch number 5: ON* ☐ OFF* ☐ Switch number 6: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel: x In

DIP Switch Block 7 Switch Number: 1	Config. Inputs configuration active if Switch Block 1 number 2 is in OFF (“DIP I/O”)	Switch Number 1: ON* ☐ OFF* ☐ Setting value (refer to P114S/EN ST/A11) readout on P114D front panel:
DIP Switch Block 7 Switch Number: 2	Config. Outputs configuration active if Switch Block 1, Number 2 is in OFF (“DIP I/O”)	Switch Number 2: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel:
DIP switch block: 8 Switch number: 1-6	tIN>> (Tripping time of definite time e/f overcurrent element)	Switch Number 1: ON* ☐ OFF* ☐ Switch Number 2: ON* ☐ OFF* ☐ Switch Number 3: ON* ☐ OFF* ☐ Switch Number 4: ON* ☐ OFF* ☐ Switch Number 5: ON* ☐ OFF* ☐ Switch Number 6: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel: s
DIP switch block: 9 Switch number: 1-6	IN>> (e/f overcurrent protection)	Switch number 1: ON* ☐ OFF* ☐ Switch number 2: ON* ☐ OFF* ☐ Switch number 3: ON* ☐ OFF* ☐ Switch number 4: ON* ☐ OFF* ☐ Switch number 5: ON* ☐ OFF* ☐ Switch number 6: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel: xIen
DIP switch block: 10 Switch number: 1-4	IN> CHAR. (Type of characteristic for the 1st stage of e/f element: IN>)	Switch number 1: ON* ☐ OFF* ☐ Switch number 2: ON* ☐ OFF* ☐ Switch number 3: ON* ☐ OFF* ☐ Switch number 4: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel: type of characteristic

DIP switch block: 11 Switch number: 1-8	tIN> / TMS / TD (Tripping time of definite time e/f overcurrent element)	Switch Number 1: ON* ☐ OFF* ☐ Switch Number 2: ON* ☐ OFF* ☐ Switch Number 3: ON* ☐ OFF* ☐ Switch Number 4: ON* ☐ OFF* ☐ Switch Number 5: ON* ☐ OFF* ☐ Switch Number 6: ON* ☐ OFF* ☐ Switch Number 5: ON* ☐ OFF* ☐ Switch Number 6: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel:

DIP switch block 12 Switch number: 1-6	IN> (Current stage of earth fault overcurrent protection)	Switch number 1: ON* ☐ OFF* ☐ Switch number 2: ON* ☐ OFF* ☐ Switch number 3: ON* ☐ OFF* ☐ Switch number 4: ON* ☐ OFF* ☐ Switch number 5: ON* ☐ OFF* ☐ Switch number 6: ON* ☐ OFF* ☐ Setting value (refer to P114D/EN ST/A11) readout on P114D front panel: xIen

7.2 Settings readout via MiCOM S1

*Delete as appropriate

0000	GENERAL SETTINGS DATA	
0005	Firmware version	
0006	Hardware version	
0007	Phase nominal current In	
0008	Neutral nominal current Ien	
0768	Relay Address RS485	
0794	Baud Rate RS485	
0795	Parity RS485	
0796	DataBits RS485	
0797	StopBits RS485	
0798	Protocol RS485	Modbus RTU* ☐ IEC103* ☐
1251	Close Pulse Time tC	
1252	Trip Pulse Time tT	
1253	Output pulse tP.	
1254	t CB not ready	
1258	Latching of LEDs	Yes* ☐ No* ☐
1249	Phase CT ratio	
1250	E/F CT ratio	

	I/O CONFIGURATION	
1040	Active Input Configuration Group	Group 1* ☐ Group 2* ☐ Group 3* ☐
1041	Active Output Configuration Group	Group 1* ☐ Group 2* ☐ Group 3* ☐

OVERCURRENT

Group 1 Settings		Settings
1024	I> Function	
1025	I> Current Set	
1026	I> Time Delay/TMS/TD	
1027	I> Curve Type	
1031	I> Reset Char.	
1028	I>> Function	
1029	I>> Current Set	
1030	I>> Time Delay	

EARTH FAULT1 (Measured)

Group 1 Settings		Group 1 Settings
1033	IN> Function	
1034	IN> Current	
1035	I> Time Delay/TMS/TD	
1036	IN> Curve Type	
1031	IN> Reset Char.	
1037	IN>> Function	
1038	I>> Current Set	
1039	I>> Time Delay	

INPUT GROUP 1

Group 1 Settings		Input L1	Input L2
1057	Block outputs		
1058	Reset latched outputs		
1059	Reset latched LEDs		
1060	Blocking scheme I>		
1061	Blocking scheme I>>		
1063	Blocking scheme IN>		
1064	Blocking scheme IN>>		
1065	AUX		
1066	52A		
1067	52B		
1068	CB not Ready		

INPUT GROUP 2

Group 2 Settings		Input L1	Input L2
1089	Block outputs		
1090	Reset latched outputs		
1091	Reset latched LEDs		
1092	Blocking scheme I>		
1093	Blocking scheme I>>		
1095	Blocking scheme IN>		
1096	Blocking scheme IN>>		
1097	AUX		
1098	52A		
1099	52B		
1100	CB not Ready		

INPUT GROUP 3

Group 3 Settings		Input L1	Input L2
1121	Block outputs		
1122	Reset latched outputs		
1123	Reset latched LEDs		
1124	Blocking scheme I>		
1125	Blocking scheme I>>		
1127	Blocking scheme IN>		
1128	Blocking scheme IN>>		
1129	AUX		
1130	52A		
1131	52B		
1132	CB not Ready		

OUTPUT Group 1

Group 1 Settings		RL1	RL2	RL3	RL4
1152	Any protection trip				
1153	Any trip (pulse tT),				
1154	start I>				
1155	start I>>				
1156	start IN>				
1157	start IN>>				
1158	tI>				
1159	tI>>				
1160	tIN>				
1161	tIN>>				
1162	AUX				
1163	Any trip with tP pulse				
1164	Close of CB				
1165	Trip of CB				
1166	CB not ready				
1167	Latching outputs				

OUTPUT Group 2

Group 2 Settings		RL1	RL2	RL3	RL4
1185	Any protection trip				
1186	Any trip (pulse tT),				
1187	start I>				
1188	start I>>				
1189	start IN>				
1190	start IN>>				
1191	tI>				
1192	tI>>				
1193	tIN>				
1194	tIN>>				
1195	AUX				
1196	Any trip with tP pulse				
1197	Close of CB				
1198	Trip of CB				
1199	CB not ready				
1200	Latching outputs				

OUTPUT Group 3

Group 3 Settings		RL1	RL2	RL3	RL4
1217	Any protection trip				
1218	Any trip (pulse tT),				
1219	start I>				
1220	start I>>				
1221	start IN>				
1222	start IN>>				
1223	tI>				
1224	tI>>				
1225	tIN>				
1226	tIN>>				
1227	AUX				
1228	Any trip with tP pulse				
1229	Close of CB				
1230	Trip of CB				
1231	CB not ready				
1232	Latching outputs				

Commissioning Engineer

Customer Witness

Date:

Date:

CM

MAINTENANCE

MT

Date: 20th February 2008

Hardware Suffix: AA

Software Version: 7B

Connection Diagrams: 10P114D01

MT

CONTENTS

MT

1. MAINTENANCE

1.1 Maintenance period

It is recommended that products supplied by Schneider Electric receive periodic monitoring after installation. In view of the critical nature of protective relays and their infrequent operation, it is desirable to confirm that they are operating correctly, at regular intervals.

Schneider Electric protective relays are designed for a life in excess of 20 years.

MiCOM relays are self-monitoring and so require less maintenance than earlier designs of relay. Most problems will set off an alarm so that remedial action can be taken. However, some periodic tests should be done to ensure that the relay is functioning correctly and the external wiring is intact.

1.2 Maintenance checks

Although some functionality checks can be performed from a remote location by utilizing the communications ability of the relays, these are predominantly restricted to checking that the relay is measuring the applied currents accurately. Therefore it is recommended that maintenance checks are performed locally (i.e. at the substation itself).

Before carrying out any work on the equipment, the user should be familiar with the contents of the Safety Guide SFTY/4L M/E11 or later issue, OR the safety and technical data section of the technical manual and also the ratings on the equipment rating label.

For safety reasons, no work must be carried out on the P114D until all power sources to the unit have been disconnected.

1.2.1 Binary Inputs

Binary inputs can be checked to ensure that the relay responds to its energization by repeating the commissioning test detailed in section 4.2.2 of the Commissioning section (P114D/EN CM).

1.2.2 Outputs

The output relays can be checked to ensure that they operate by repeating the commissioning test detailed in section 5.2.1.4 of the Commissioning section (P114D/EN CM).

1.2.3 Measurement accuracy

The P114D does not have a display. For this reason it is not possible to check measuring accuracy without tripping protection elements or connection to a PC installed with “Measurement Viewer” software, available in the MiCOM S1 package.

To check accuracy of protection elements refer to sections 5.2 of the Commissioning section (P114D/EN CM). These tests will establish whether calibration accuracy is being maintained.

1.3 Method of repair

It is recommended that the P114D relay is returned to an Schneider Electric service centre for repair.

Before carrying out any work on the equipment, the user should be familiar with the contents of the Safety Guide SFTY/4L M/E11 or later issue, OR the safety and technical data section of the technical manual and also the ratings on the equipment rating label.

For safety reasons, no work must be carried out on the P114D until all power sources to the unit have been disconnected.

1.4 Cleaning

Before cleaning the equipment ensure that all current transformers and voltage input connections are isolated to prevent any possibility of an electric shock whilst cleaning.

The equipment may be cleaned using a lint-free cloth moistened with clean water. The use of detergents, solvents or abrasive cleaners is not recommended as they may damage the relay's surface and leave a conductive residue.

TROUBLESHOOTING

TS

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

TS

CONTENTS

TS

1. INTRODUCTION

Before carrying out any work on the equipment, the user should be familiar with the contents of the Safety Guide SFTY/4L M/E11 or later issue, OR the safety and technical data section of the technical manual and also the ratings on the equipment rating label.

For safety reasons, no work must be carried out on the P114D until all power sources to the unit have been disconnected.

The purpose of this section of the service manual is to allow an error condition on the relay to be identified so that appropriate corrective action can be taken.

In cases where a faulty relay is being returned to the manufacturer or one of their approved service centers, a completed copy of the Repair/Modification Return Authorization Form located at the end of this section should be included.

2. INITIAL PROBLEM IDENTIFICATION

Consult the table below to find the description that best matches the problem experienced, then consult the section referenced to perform a more detailed analysis of the problem.

Symptom	Refer To
Relay fails to power up	Section 3
Maloperation of the relay during testing	Section 4

Table 1: Problem identification

3. POWER UP ERRORS

P114D can be powered up in the following ways:

- USB connection with PC (Yellow LED should be flashing for a short period after establishing cable connection).
- Auxiliary voltage (Vx)
- Current inputs

If the relay does not appear to power up then the following procedure can be used to determine whether the fault is in the external wiring or in the power supply module of the relay.

Test	Check	Action
1	1. Connect the P114S to a PC via the USB port. 2. Disconnect the PC from the P114S USB port.	(i) If the green "Healthy" LED is lit then proceed to test 2. (ii) If the green "Healthy" LED is not lit then proceed to test 2.
2	1. Apply a Vx auxiliary voltage on terminals 11-12 (check the level on the P114D nominal label) 2. Check whether the green "Healthy" LED on the P114D front panel is lit. 3. Disconnect the ac auxiliary voltage from terminals 11-12.	(i) If the green "Healthy" LED is lit then proceed to test 3. (ii) If the green "Healthy" LED is not lit then send the relay back to Schneider Electric repair centre.
3	1. Connect the Current Test equipment to the current input terminals: 1-2. 2. Apply 0.2 In current 3. Disconnect the Current Test equipment from current input terminals: 1-2. 4. Repeat procedure for terminals: 3-4, 5-6 and 7-9 (0.2 Ien)	(i) If the green "Healthy" LED is not lit in all four tests, it means that P114D is damaged. Send the relay back to Schneider Electric repair centre. (ii) If the green "Healthy" LED is lit in test 1 and 2 but not lit in test 3, check the current circuit wiring. If all connections are OK, send the relay and CTs back to Schneider Electric repair centre. (iii) If the green "Healthy" LED is lit in test 1 and 3 but not lit in test 2, check the auxiliary voltage level on terminals 11-12 and connections in that circuit. If all connections are OK and the voltage level is in the required range (refer to technical data of manual), send the relay back to Schneider Electric repair centre.

Table 2: Failure of relay to power up

4. MALOPERATION OF THE RELAY DURING TESTING

4.1 Failure of opto-isolated inputs

The opto-isolated inputs are mapped onto the relay internal signals using DIP switch or/and configuration via MiCOM S1 setting software. If the opto-isolated input does not appear to be read correctly then it is necessary to check its mapping within DIP switch setting or/and MiCOM S1 setting software. To be sure that the problem is not in configuration, it is recommended that the configuration is changed to DIP switches (refer to P114D_EN_ST_A11 part of this manual):

- DIP switch “Config.” Switch Block 1 Number 2: OFF (I/O settings configuration: “DIP I/O”),
- DIP switch “I/O config” Switch Block 7 Number 1: ON (“L1 – AUX”)
- DIP switch “I/O config” Switch Block 7 Number 2: OFF (“RL – GROUP 1”),

Note: Record previous I/O configuration for restoration after tests.

Above configuration is as follows:

Configuration I/O made via DIP (Switches Block 7: “DIP I/O”).

- Input configuration:
  - L1 is configured for AUX function (external trip via Binary Input function)
  - L2 is configured to reset of LEDs and latched outputs
- Output configuration:
  - RL1: any trip (I>, I>>, IN>, IN>>, AUX)
  - RL2: any trip (I>, I>>, IN>, IN>>, AUX)
  - RL3: any trip any trip (I>, I>>, IN>, IN>>, AUX) with latching via fixed time (3 days)
  - RL4: I>> (start of I>> protection element)
  - Flag Indicator output: any trip (I>, I>>, IN>, IN>>, AUX)
  - Low Energy Trip Output: follows RL1, so: any trip (I>, I>>, IN>, IN>>, AUX)

Test	Check	Action
1	1. Record configuration of P114D (position of DIP switches on the front panel) manually or via setting software MiCOM S1	
2	1. Apply configuration as described below: a) DIP Switch Block 1 Number 2 (“**DIP I/O**” / ”USB I/O”) : **OFF** b) DIP Switch Block 7 Number 1 (“L1- block I>>” / ”**L1 –AUX**”): **ON** c) DIP Switch Block 7 Number 2 (“**RL – GROUP 1**” / “RL – GROUP 2”): **OFF** refer to P114D_EN_ST_A11 part of this manual	Following configuration is applied: (i) L1 is configured for AUX function (external trip via Binary Input function) (ii) L2 is configured to reset of LEDs and latched outputs (iii) RL1: any trip (I>, I>>, IN>, IN>>, AUX) (iv) RL2: any trip (I>, I>>, IN>, IN>>, AUX) (v) RL3: any trip any trip (I>, I>>, IN>, IN>>, AUX) with latching via fixed time (3 days) (vi) RL4: I>> (start of I>> protection element)

Test	Check	Action
2	1. Apply auxiliary voltage Vx on the L1 terminals (13-15) Refer to nominal label of P114D to be sure of Vx range 2. Check whether output contacts and “AUX” LED work correctly	(i) If following outputs close contacts: RL1 (terminals: 16-17), RL2 (terminals: 19-20), RL3 (terminals: 22-23) output contacts and lights “AUX” LED then proceed to test 3. (ii) If following outputs do not close contacts: RL1 (terminals: 16-17), RL2 (terminals: 19-20), RL3 (terminals: 22-23) output contacts and lights “AUX” LED then send the relay back to Schneider Electric repair centre.
3	1. Disconnect auxiliary voltage from L1 terminals. 2. Check whether output contacts and “AUX” LED work correctly	(i) If outputs: RL1 (terminals: 16-17) and RL2 (terminals: 19-20) open contacts, RL3 (terminals: 22-23) output contacts remain closed and light “AUX” LED and it remains lit then proceed to test 4. (ii) If outputs: RL1 (terminals: 16-17) and/or RL2 (terminals: 19-20) remain closed, RL3 (terminals: 22-23) output contacts do not remain closed and light “AUX” LED, but it does not remain lit then send the relay back to Schneider Electric repair centre.
4	1. Apply auxiliary voltage Vx on the L2 terminals (14-15) Refer to nominal label of P114D to be sure of Vx range 2. Check whether output contacts and “AUX” LED work correctly	(i) If RL3 (terminals: 22-23) output contacts open (contacts) and light “AUX” LED, and it is reset then opto-inputs are OK, proceed to test 5. (ii) If RL3 (terminals: 22-23) output contacts remain closed and/or “AUX” LED is not reset then send the relay back to Schneider Electric repair centre.
5	1. Disconnect auxiliary voltage from L2 terminals.	
6	1. Return to previous I/O configuration (before test 1)	

4.2 Failure of output contacts

An apparent failure of the relay output contacts may be caused by the relay configuration; the following tests should be performed to identify the real cause of the failure.

Apply the same input and output configuration as in section "4.1 Failure of opto isolated inputs" of this chapter:

- DIP Switch Block 1 Number 2 ("**DIP I/O**" / "USB I/O"): **OFF**
- DIP Switch Block 7 Number 1 ("L1- block I>>" / "**L1 –AUX**"): **ON**
- DIP Switch Block 7 Number 2 ("**RL – GROUP 1**" / "RL – GROUP 2"): **OFF**

For further details refer to chapter P114D/EN ST of this manual.

Test	Check	Action
1	1. Record configuration of P114D (position of DIP switches on the front panel) manually or via setting software MiCOM S1	
2	1. Apply configuration as described below: a) DIP Switch Block 1 Number 2 ("**DIP I/O**" / "USB I/O"): **OFF** b) DIP Switch Block 7 Number 1 ("L1- block I>>" / "**L1 –AUX**"): **ON** c) DIP Switch Block 7 Number 2 ("**RL – GROUP 1**" / "RL – GROUP 2"):: **OFF** refer to P114D_EN_ST_A11 part of this manual	Following configuration is applied: (i) L1 is configured for AUX function (external trip via Binary Input function) (ii) L2 is configured to reset of LEDs and latched outputs (iii) RL1: any trip (I>, I>>, IN>, IN>>, AUX) (iv) RL2: any trip (I>, I>>, IN>, IN>>, AUX) (v) RL3: any trip any trip (I>, I>>, IN>, IN>>, AUX) with latching via fixed time (3 days) (vi) RL4: I>> (start of I>> protection element)
2	1. Apply auxiliary voltage Vx on the L1 terminals (13-15) Refer to nominal label of P114D to be sure of Vx range 2. Check whether output contacts and "AUX" LED work correctly	(i) If following outputs close contacts: RL1 (terminals: 16-17), RL2 (terminals: 19-20), RL3 (terminals: 22-23) output contacts and lights "AUX" LED then proceed to test 3. (ii) If following outputs do not close contacts: RL1 (terminals: 16-17), RL2 (terminals: 19-20), RL3 (terminals: 22-23) output contacts and lights "AUX" LED then send the relay back to Schneider Electric repair centre.
3	1. Take off auxiliary voltage from L1 terminals. 2. Check whether output contacts and "AUX" LED work correctly	(i) If outputs: RL1 (terminals: 16-17) and RL2 (terminals: 19-20) open contacts, RL3 (terminals: 22-23) output contacts remain closed and light "AUX" LED and it remains lit then proceed to test 4. (ii) If outputs: RL1 (terminals: 16-17) and/or RL2 (terminals: 19-20) remain closed, RL3 (terminals: 22-23) output contact doesn't remain closed and lights "AUX" LED, but it doesn't remain lit then send the relay back to Schneider Electric repair centre.

Test	Check	Action
4	2. Apply auxiliary voltage Vx on the L2 terminals (14-15) Refer to nominal label of P114D to be sure of Vx range 2. Check whether output contacts and “AUX” LED work correctly	(i) If RL3 (terminals: 22-23) output opens (contacts) and lights “AUX” LED and it is reset then opto-inputs are OK, proceed to test 5. (ii) If RL3 (terminals: 22-23) output contacts remain closed and/or “AUX” LED is not reset then send the relay back to Schneider Electric repair centre.
5	1. Disconnect auxiliary voltage from L2 terminals.	(i) Proceed to test 6
6	1. Connect the Current Test equipment to the current input terminals: 1-2. 2. Apply current above I>> stage. 3. Disconnect the Current Test equipment from current input terminals: 1-2.	(i) If start of I>> protection element closes RL4 output then proceed to test 7 (ii) If start of I>> protection element does not close RL4 output then send the relay back to Schneider Electric repair centre
6	1. Return to previous I/O configuration (before test 1)	

5. REPAIR AND MODIFICATION PROCEDURE

Please follow these 5 steps to return an Automation product to us:

1. Get the Repair and Modification Authorization Form (RMA)

Find a copy of the RMA form at the end of this section.

- To obtain an electronic version of the RMA form for e-mailing, please contact your local Schneider Electric service.

2. Fill

Fill in only the white part of the form.

Please ensure that all fields marked **(M)** are completed such as:

- Equipment model
- Model No. and Serial No.
- Description of failure or modification required (please be specific)
- Value for customs (in case the product requires export)
- Delivery and invoice addresses
- Contact details

3. Send RMA form to your local Schneider Electric contact

4. Receive from local service contact, the information required to ship the product

Your local service contact will provide you with all the information:

- Pricing details
- RMA n°
- Repair centre address

If required, an acceptance of the quote must be delivered before going to next stage.

5. Send the product to the repair centre

- Address the shipment to the repair centre specified by your local contact
- Ensure all items are protected by appropriate packaging: anti-static bag and foam protection
- Ensure a copy of the import invoice is attached with the unit being returned
- Ensure a copy of the RMA form is attached with the unit being returned
- E-mail or fax a copy of the import invoice and airway bill document to your local contact.

TS

SYMBOLS AND GLOSSARY

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

SG

Logic Symbols

Symbols	Explanation
>	**Greater than:** Used to indicate an “over” threshold, such as overcurrent (current overload).
C/O	**A changeover contact having normally closed and normally open connections:** Often called a “form C” contact.
CB	Circuit breaker.
CT	Current transformer.
Dly	Time delay.
DT	**Abbreviation of “Definite Time”:** An element which always responds with the same constant time delay on operation.
E/F	**Earth fault:** Directly equivalent to ground fault.
FLC	**Full load current:** The nominal rated current for the circuit.
Flt.	**Abbreviation of “Fault”:** Typically used to indicate faulted phase selection.
FN	Function.
Gnd.	**Abbreviation of “Ground”:** Used in distance settings to identify settings that relate to ground (earth) faults.
I	Current.
I>	**Second stage of phase overcurrent protection:** Could be labelled 51-2 in ANSI terminology.
I>>	**Third stage of phase overcurrent protection:** Could be labelled 51-3 in ANSI terminology.
IN>	**Earth Fault current:** Equals measured on analogue input neutral current.
IA	**Phase A current:** Might be phase L1, red phase.. or other, in customer terminology.
IB	**Phase B current:** Might be phase L2, yellow phase.. or other, in customer terminology.
IC	**Phase C current:** Might be phase L3, blue phase.. or other, in customer terminology.
IDMT	**Inverse definite minimum time:** A characteristic whose trip time depends on the measured input (e.g. current) according to an inverse-time curve.
In	**The rated nominal current of the CT:** Software selectable as 1 amp or 5 amp to match the line CT input.
Ien	**The rated nominal current of the E/F CT:** Software selectable as 1 amp or 5 amp to match the line E/F CT input.
IN	**Neutral current, or residual current:** This results from an external summation of the three measured phase currents.

Symbols	Explanation
Inst.	**An element with "instantaneous" operation:** i.e. having no deliberate time delay.
I/O	**Abbreviation of "Inputs and Outputs":** Used in connection with the number of opto-coupled inputs and output contacts within the relay.
I/P	Abbreviation of "Input".
LD	**Abbreviation of "Level Detector":** An element responding to a current or voltage below its set threshold.
LED	**Light emitting diode:** Red or green indicator on the relay front-panel.
N	**Indication of "Neutral" involvement in a fault:** i.e. a ground (earth) fault.
N/A	Not applicable.
N/C	**A normally closed or "break" contact:** Often called a "form B" contact.
N/O	**A normally open or "make" contact:** Often called a "form A" contact.
O/P	Abbreviation of "output".
Opto	**An opto-coupled logic input:** Alternative terminology: binary input.
PCB	Printed circuit board.
Ph	**Abbreviation of "Phase":** Used in distance settings to identify settings that relate to phase-phase faults.
R	A resistance.
Rx	**Abbreviation of "Receive":** Typically used to indicate a communication receive line/pin.
T	A time delay.
TE	**A standard for measuring the width of a relay case:** One inch = 5TE units.
TMS	The time multiplier setting applied to IEC or UK inverse-time curves
TD	The time multiplier setting applied to IEEE or US inverse-time curves
Tx	**Abbreviation of "Transmit":** Typically used to indicate a communication transmit line/pin.

INSTALLATION

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

IN

CONTENTS

FIGURES

IN

1. RECEIPT OF RELAYS

Upon receipt, relays should be examined immediately to ensure no external damage has been sustained in transit. If damage has been sustained, a claim should be made to the transport contractor and Schneider Electric should be promptly notified.

Relays that are supplied unmounted and not intended for immediate installation should be returned to their protective polythene bags and delivery carton. Section 3 of P114D/EN IN gives more information about the storage of relays.

2. HANDLING OF ELECTRONIC EQUIPMENT

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semi-conductor devices when handling electronic circuits can cause serious damage that, although not always immediately apparent, can reduce the reliability of the circuit. The relay's electronic circuits are protected from electrostatic discharge when housed in the case. Do not expose them to risk by removing the front panel or printed circuit boards unnecessarily.

Each printed circuit board incorporates the highest practicable protection for its semi-conductor devices. However, if it becomes necessary to remove a printed circuit board, the following precautions should be taken to preserve the high reliability and long life for which the relay has been designed and manufactured.

Before removing a printed circuit board, ensure that you are at the same electrostatic potential as the equipment by touching the case.

Handle analog input modules by the front panel, frame or edges of the circuit boards. Printed circuit boards should only be handled by their edges. Avoid touching the electronic components, printed circuit tracks or connectors.

Do not pass the module to another person without first ensuring you are both at the same electrostatic potential. Shaking hands achieves equipotential.

Place the module on an anti-static surface, or on a conducting surface that is at the same potential as you.

If it is necessary to store or transport printed circuit boards removed from the case, place them individually in electrically conducting anti-static bags.

In the unlikely event that you are making measurements on the internal electronic circuitry of a relay in service, it is preferable that you are earthed to the case with a conductive wrist strap. Wrist straps should have a resistance to ground between 500kΩ to 10MΩ. If a wrist strap is not available you should maintain regular contact with the case to prevent a build-up of electrostatic potential. Instrumentation which may be used for making measurements should also be earthed to the case whenever possible.

More information on safe working procedures for all electronic equipment can be found in BS EN 100015: Part 1:1992. It is strongly recommended that detailed investigations on electronic circuitry or modification work should be carried out in a special handling area such as described in the British Standard document.

3. STORAGE

If relays are not to be installed immediately upon receipt, they should be stored in a place free from dust and moisture in their original cartons. Where de-humidifier bags have been included in the packing they should be retained.

Care should be taken on subsequent unpacking that any dust, which has collected on the carton, does not fall inside. In locations of high humidity the carton and packing may become impregnated with moisture and the de-humidifier crystals will lose their efficiency.

Prior to installation, relays should be stored at a temperature of between –25˚C to +70˚C (-13˚F to +158˚F).

4. UNPACKING

Care must be taken when unpacking and installing the relays so that none of the parts are damaged and additional components are not accidentally left in the packing or lost. Ensure that any User's CDROM or technical documentation is NOT discarded – this should accompany the relay to its destination substation.

Relays must only be handled by qualified persons.

The site should be well lit to facilitate inspection, clean, dry and reasonably free from dust and excessive vibration.

5. RELAY MOUNTING

Individual relays are normally supplied with an outline diagram showing the dimensions. This information can also be found in the product publication.

Wall-mounting only is available.

The relay is mounted onto a panel by means of four:

- 4.5mm ∅ drill holes: flush mounting case
- 5.5mm ∅ drill holes: wall mounting case

Detailed drawing with all measurements can be found in Figure 1.

6. RELAY WIRING

This section serves as a guide to selecting the appropriate cable and connector type for each terminal on the MiCOM relay.

Before carrying out any work on the equipment, the user should be familiar with the contents of the Safety Guide SFTY/4L M/E11 or later issue, OR the safety and technical data section of the technical manual and also the ratings on the equipment rating label.

For safety reasons, no work must be carried out on the P114D until all power sources to the unit have been disconnected.

The measuring current inputs of the P114D should be connected to the secondary wires of the power system CTs as shown in the connection diagrams of "8. External Connection Diagram" of this chapter P114D/EN IN.

The CT types which can be connected to the P114D's current input terminals are shown in section 3 of Applications chapter P114D/EN AP.

6.1 Terminal block connections

AC Current Input Terminals

Threaded M3 screw-type plug-in terminals, with wire protection for conductor cross-section

- 0.2 - 6mm^2 single-core
- 0.2 - 4mm^2 finely stranded

General Input/Output Terminals

For power supply, opto and contact inputs, output contacts and COM for rear communications.

Threaded M3 screw-type plug-in terminals, with wire protection for conductor cross-section

- 0.2 - 4mm^2 single-core
- 0.2 - 2.5mm^2 finely stranded

Connections to the equipment must only be made using single strand wire or stranded wire with the use of insulated crimp terminals to maintain insulation requirements.

Where UL Listing of the equipment is not required the recommended fuse type for external wiring is a high rupture capacity (HRC) type with a maximum current rating of 16 Amps and a minimum d.c. rating of 250 Vdc, for example the Red Spot NIT or TIA type.

To maintain UL and CUL Listing of the equipment for North America a UL Listed fuse shall be used. The UL Listed type shall be a Class J time delay fuse, with a maximum current rating of 15 A and a minimum d.c. rating of 250 Vdc, for example type AJT15.

The protective fuse(s) should be located as close to the unit as possible.

For safety reasons, current transformer circuits must never be fused. Other circuits should be appropriately fused to protect the wire used.

6.2 USB port

Connection to the USB port can be made by means of a USB cable. The USB port allows the user to download settings or fault records from the P114D or change I/O configuration.

To access this port it is necessary to remove the cover plate (protection against unauthorized setting changes) on the P114D front panel.

A typical cable specification would be:

- (i) Type of cable: USB 2.0
- Connectors:
  - PC: type A male
  - P114D: type mini B male

6.3 Rear Communications Port

EIA(RS)485 signal levels, two wire

Connections located on general purpose block, M3 screw

For screened twisted pair cable, multi-drop, 1000m max.

For Modbus RTU protocol.

Isolation to SELV level.

7. CASE DIMENSIONS

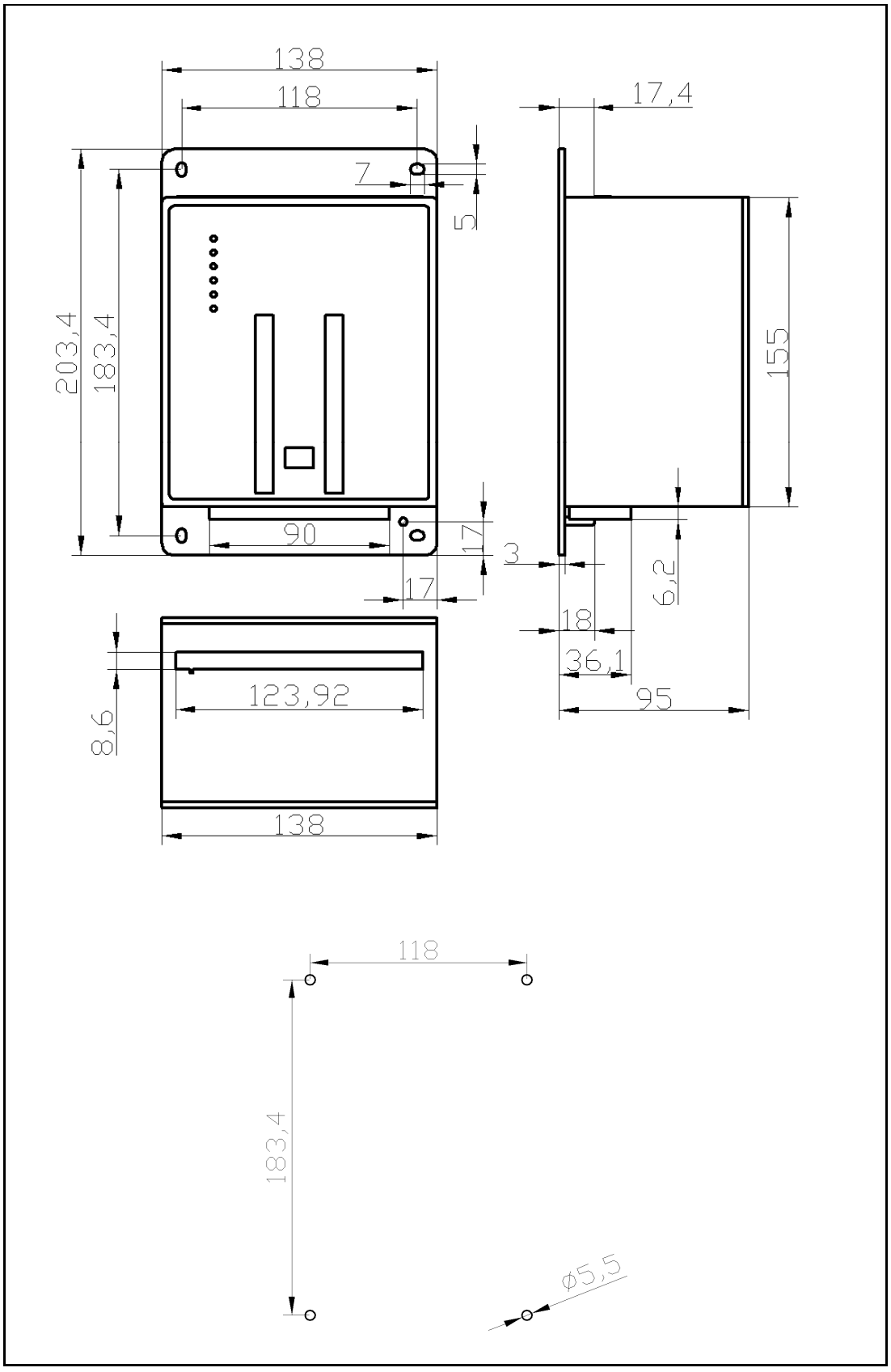


Figure 1: Dimensions. P114D wall mounting case

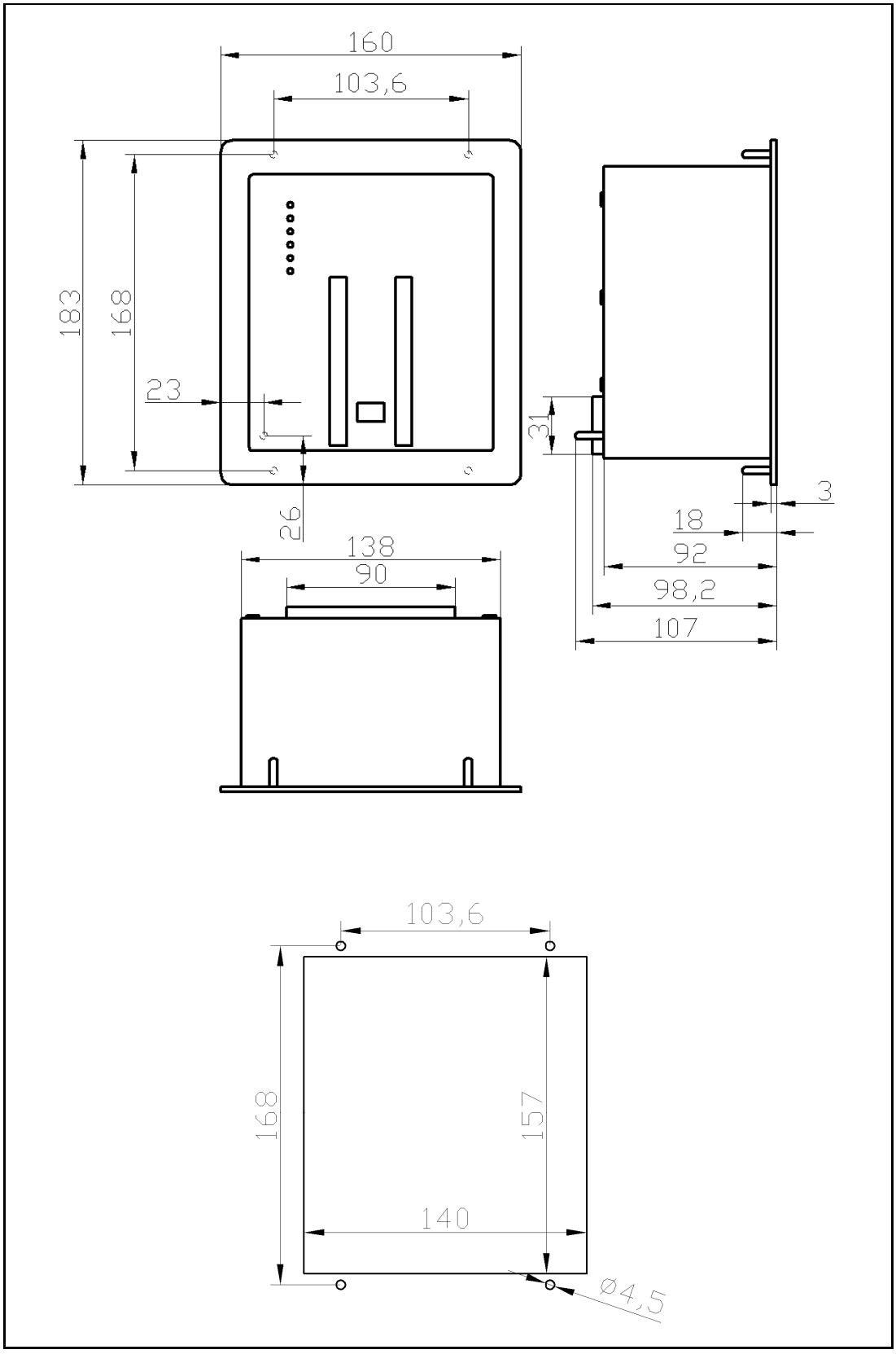


Figure 2: Dimensions. P114D flush mounting case

8. EXTERNAL CONNECTION DIAGRAMS

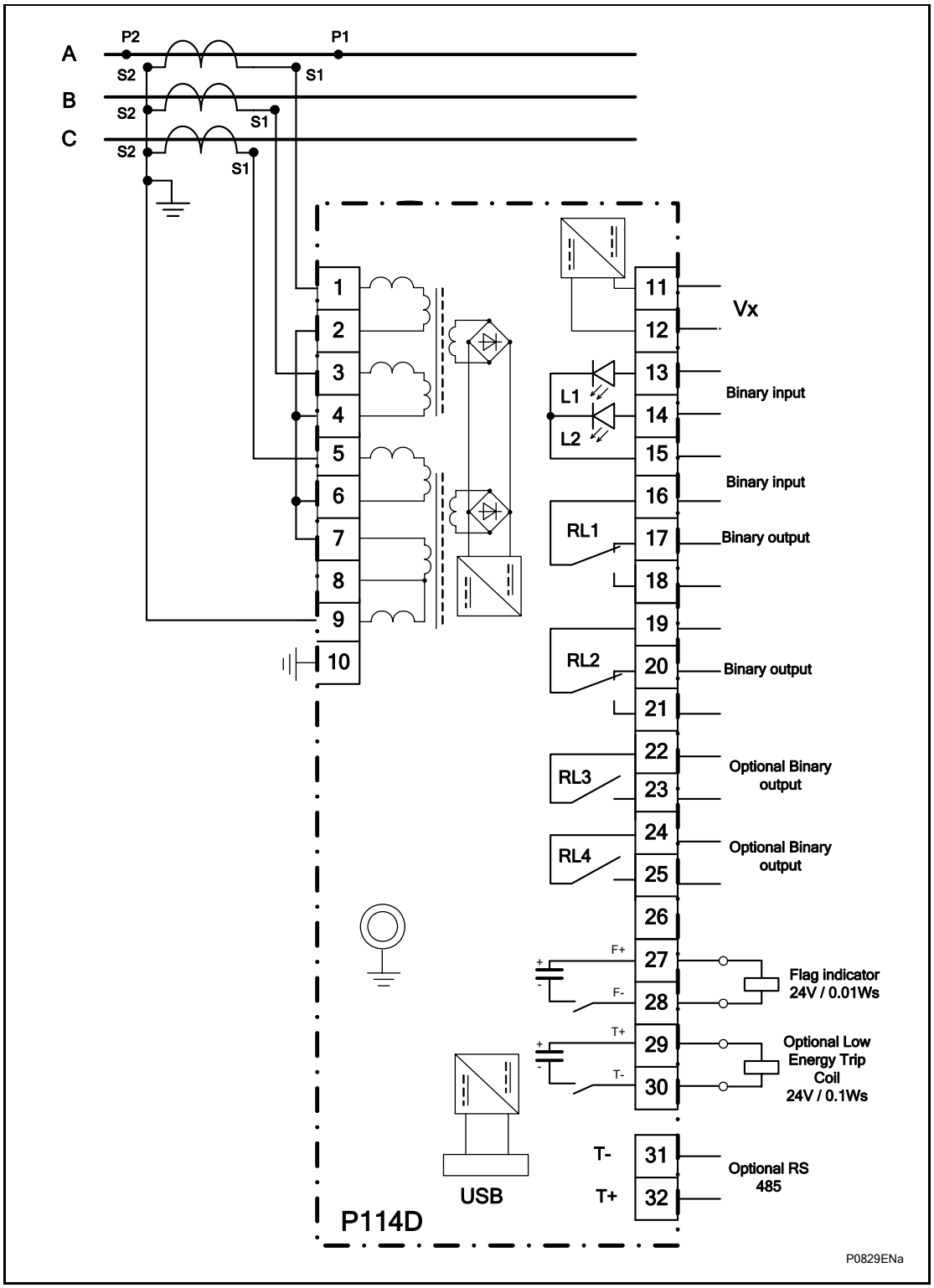


Figure 3: 3 phase CTs connection

IN

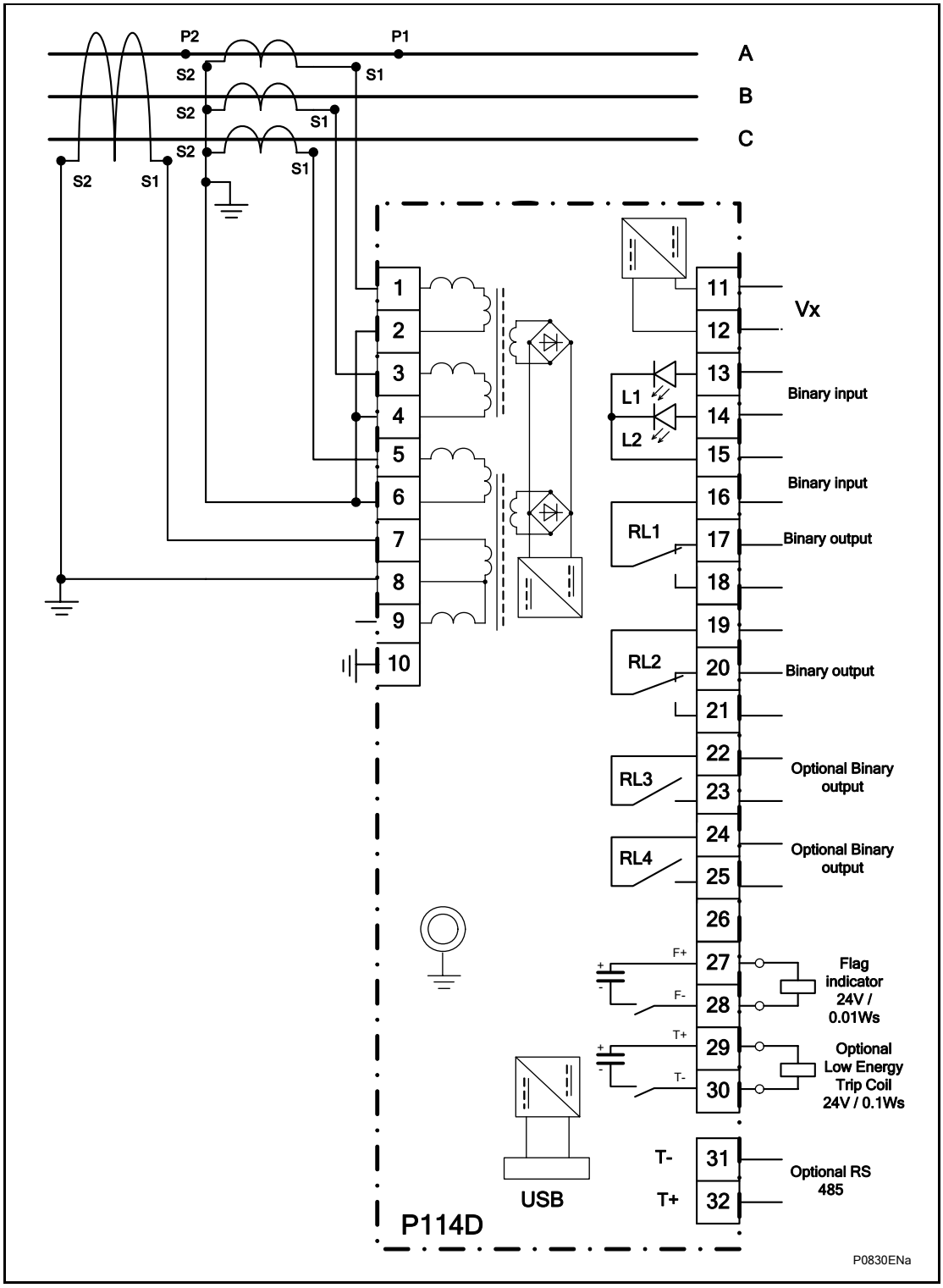


Figure 4: 3 phase CTs + Core balanced CT connection

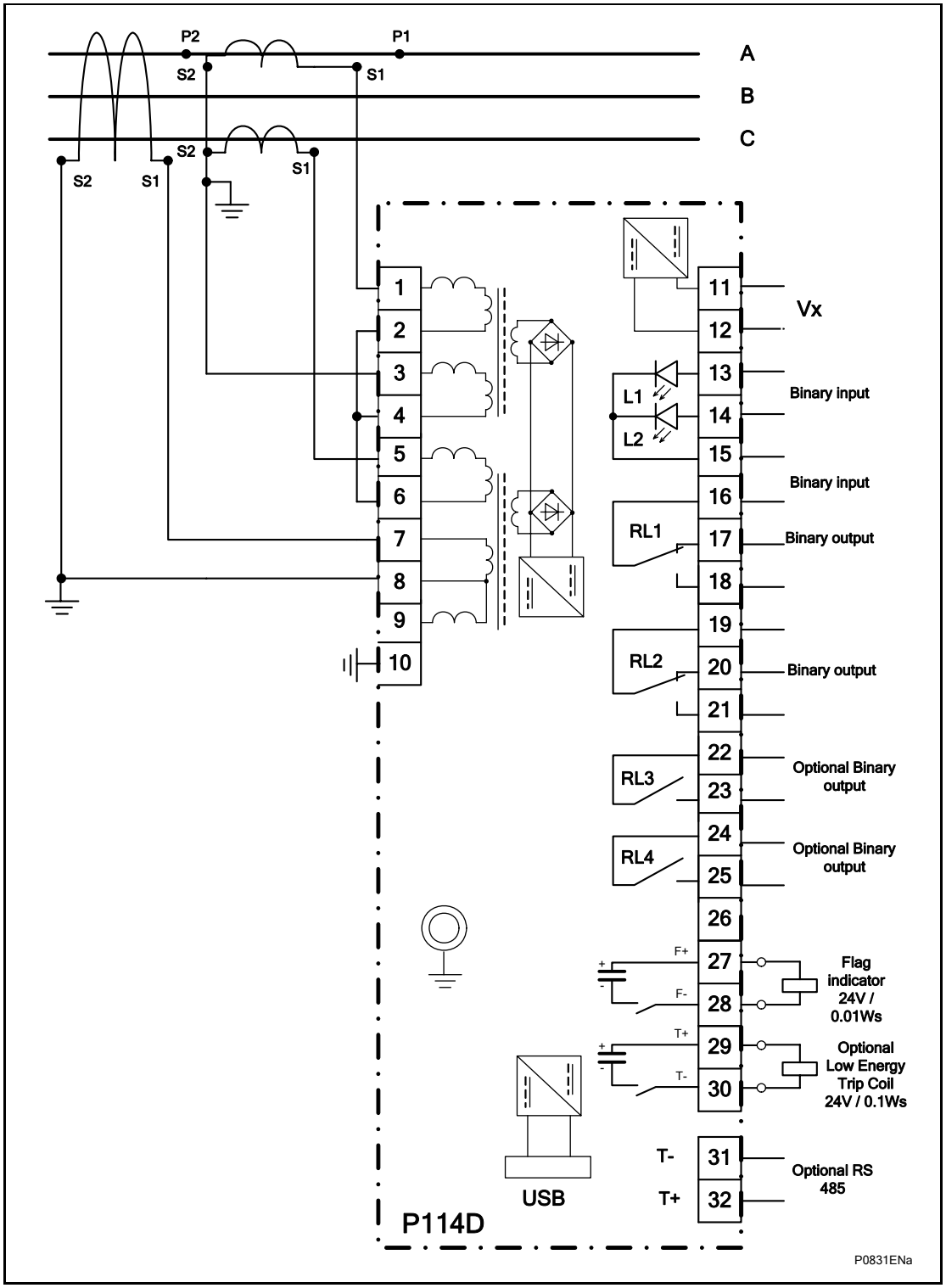


Figure 5: 2 phase CTs + Core balanced CT connection

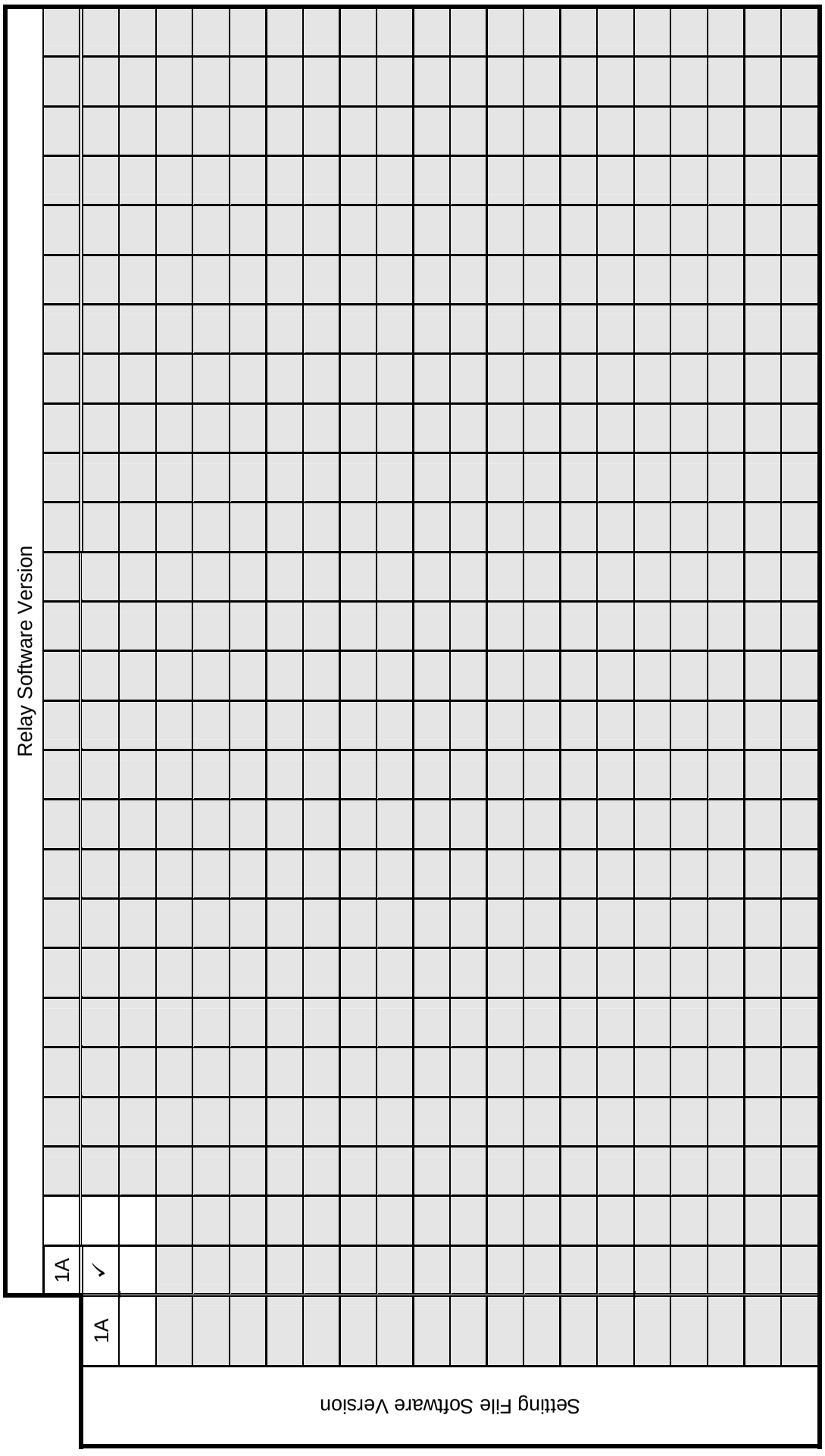
IN

FIRMWARE AND SERVICE MANUAL VERSION HISTORY

Date:	**20th February 2008**
Hardware Suffix:	**A**
Software Version:	**1A**
Connection Diagrams:	**10P114D01**

VH

Relay type: P114D …						
Software Version		**Hardware Suffix**	**Original Date of Issue**	**Description of Changes**	**S1 Compatibility**	**Technical Documentation**
Major	Minor					
1	A	A	November 2007	✓ Original Issue	V2.12	P114D/EN M/A11


Relay Software Version
1A
✓
1A
Setting File Software Version